TOWN OF CALEDON
PLANNING
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Sept. 17, 2021

Kennedy Pond – Stormwater Management Facility Retrofit

Mayfield Road and Kennedy Road

Town of Caledon
Region of Peel

GHD | 65 Sunray Street Whitby Ontario L1N 8Y3 Canada

11129100 | 200 | Report No 3 | May 2017

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1. Introduction

The Region of Peel has been monitoring its stormwater facilities so that the performance of each facility can be understood and tracked over time. Stormwater facilities are designed according to standards of the day but monitoring will reveal if the facility is meeting the targets set during design for pollutant removal, extended detention and quantity control. This report will look at one facility owned and operated by the Region of Peel at the northeast corner of Mayfield Road and Kennedy Road.

The Kennedy Road Stormwater Management Facility has had a monitoring program on this facility and two others under its jurisdiction from December 2014 onwards. Calder Engineering was retained by the Region of Peel to provide the equipment, collect the results and provide an analysis of the data collected. The collected data and analysis has revealed that the Kennedy Facility experiences some shortfalls in water quality control for relatively minor storm events.

The Region of Peel retained GHD Limited to perform a Class Environmental Assessment to review the pond and determine what actions are required if any to improve the conveyance and stormwater quality control treatment of the Mayfield Road and Kennedy Road drainage. Other design parameters that the Region of Peel has requested be investigated with the design alternatives is to improve the ease and efficiency of pond maintenance. Given the above criteria, some possible design changes would include altering to the pond inlet and outlet, and changing the pond configuration/layout. There is also the possibility of the addition of supplemental infrastructure or changing the primary means of treatment. All of these items will be investigated and a best alternative solution selected to meet the criteria.

The following report includes a summary of a field inspection, proposed rehabilitation alternatives, a hydrologic/hydraulic review of the facility and the conclusion/recommendations based on the above analysis.

Reports and documents utilized in the preparation of this review include the following:

- Stormwater Management Design Brief, prepared by Stantec Consulting Ltd., December 7, 2007
- Stormwater Management Facility Monitoring Dec 2014 to Feb 2016 Report, prepared by Calder Engineering Ltd., March 2016
- Stormwater Management Planning and Design Manual, prepared by the Ministry of the Environment, March 2003

2. Class Environmental Assessment

The original design parameters anticipated that the works that would be required to complete the facility improvements would be classified as a Class ‘B’ Environmental Assessment(EA) process. Upon review of the requirements and issues associated with the facility, it was determined that the proposed works can be classified as a Class ‘A+’ EA process. The Class ‘A+’ plus provides for less sensitive work that is deemed as a pre-approved standard municipal project, and does not require the purchase of the additional lands. Through examination of property constraints and servicing constraints, the anticipated solutions to augment the facility did not project passed the limits of a Class ‘A+’ EA scenario. The possible solutions to improve the performance of the facility did not necessitate the purchase of additional lands and fell within standard Municipal works. As such, the design of the facility improvements was determined to fall under a typically engineering design project. The Class ‘A+’ EA designation will require the Region of Peel to provide public notice of the works prior to commencing construction.

3. Existing Conditions

The Kennedy Stormwater Management Facility is located on the northeast corner of the intersection of Mayfield Road and Kennedy Road in the Town of Caledon, Region of Peel. The pond is located on Region of Peel property, with Kennedy Road to the west, Mayfield Road to the south, and private property to the east and north. Although the area to the east is private property, the area is considered Provincial Significant Wetland which cannot be developed. The location of the SWM Facility is illustrated on **Figure 3.1**.

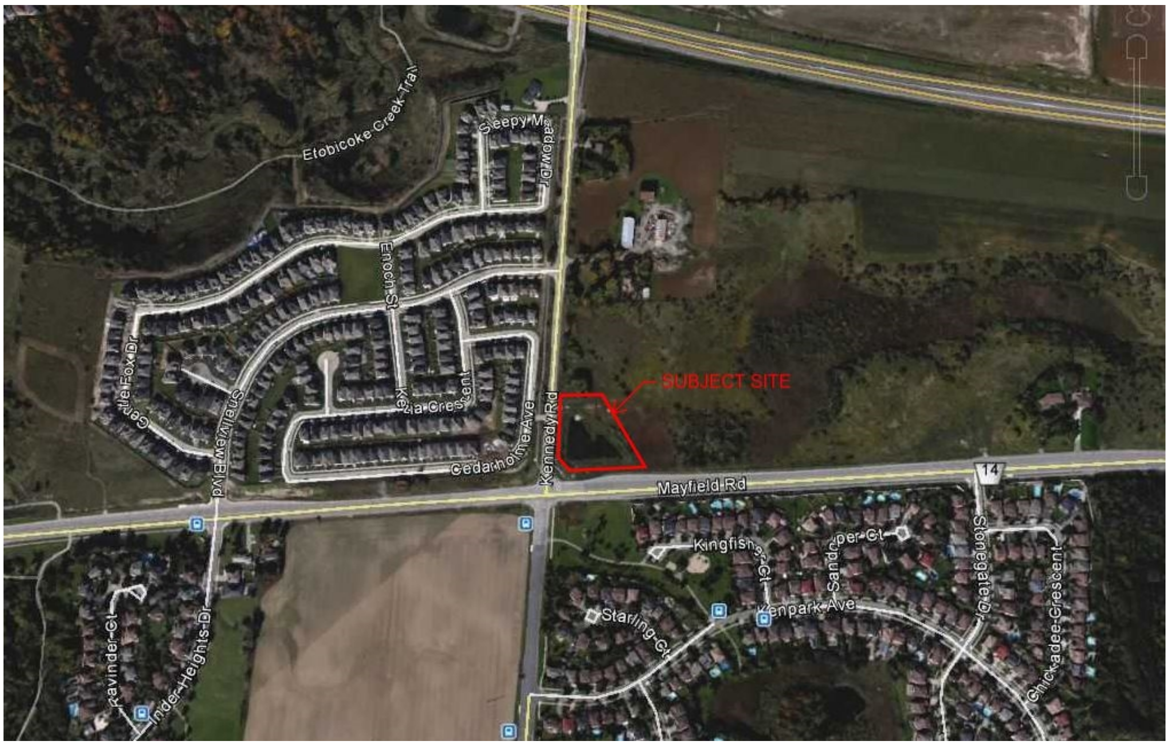


Figure 3.1 Site Location Plan

A site walk was conducted on October 26, 2016, with GHD staff and Region of Peel staff present. Different aspects of the pond were investigated including the part of the outfall structure, inlet structure, forebay, pond banks, and the condition of the pond vegetation. The visual inspection identified sediment accumulation within the forebay near the storm sewer inlet. Vegetation had begun to creep into the sewer outfall rip-rap, collecting miscellaneous garbage as well. Upon examination of the outlet structure, it was found that the water level was approximately halfway up the lower control orifice. This may have been due to a small storm event that occurred the day prior to the visit.

Figure 3.2 Overgrown Forebay Inlet – Looking West

Figure 3.3 Outlet Structure – Looking Southwest

3.1 Original Design

The original pond was designed and constructed as a Wetland SWM Facility as per the Stormwater Management Design Brief, prepared by Stantec Consulting Ltd. The design of the pond commenced in 2007 with finalized drawings and construction occurring in 2009. Based on the original design, the SWM Facility was designed to provide the stormwater quality and quantity controls for approximately 10.59ha of road allowance and field area, prior to being released along the facility's east banks and flowing to the existing wetland. Some characteristics of the original pond design are as follow:

- 718m^3 permanent pool
- 1902m^3 extended detention Erosion Control Volume
- 0.3m pond depth in main cell
- 1.5m deep sediment forebay

Other design characteristics can be found in the original report, attached in **Appendix F**. Stormwater quality design characteristics are discussed further in Section 4.1.3.

3.2 SWM Facility Monitoring and Bathometric Survey

3.2.1 Performance Monitoring

In accordance with the original Environmental Compliance Approval provided by the Ministry of Environment, the Region of Peel obtained the services of an engineering consultant to monitor the performance of the SWM Facility. Calder Engineering Ltd. performed the monitoring from December 2014 to February 2016. Water samples were taken from the pond outlet during 5 significant storm events from March 2015 to August 2015. The results found that during 3 different occasions, the Total Suspended Solids (TSS) exceeding the Region of Peel's storm sewer by-law criteria. The remaining storms were below the required level.

The Ministry of Environment(MOE) Stormwater Management Planning and Design Manual does not have requirements for a specific TSS level. The MOE criteria for stormwater management facility design is for the facility to remove a percentage of TSS during any given storm event. As the monitoring program did not include the incoming TSS content, confirmation of compliance with MOE criteria was not possible. It is noted that construction activities were continued along Mayfield Road and Kennedy Road throughout 2015 and into 2016. Although it is not known for certain, there is a high likelihood that the increased TSS levels may have been the result of higher levels of road sediment from construction activities.

3.2.2 Bathometric Survey

To understand the performance of the facility, a bathometric survey was completed to determine the accumulation of sediment over the lifespan of the facility. It is our understanding that the pond has not been serviced since initial construction. The bathometric survey found that the volume within the pond is approximately 860m^3, providing a surplus of permanent pool volume when compared to the original design. Based on this information, the existing pond has the required volume to continue to perform in accordance with Stormwater Management Planning and Design Manual.

4. Rehabilitation & Retrofit Options

The Region of Peel's initiative for the review of the existing infrastructure had two primary reasons. The first goal was to improve the performance of the existing facility in providing stormwater quality controls, and the second was to provide a more efficient means of maintaining the facility, both in terms of cost and execution. Several options were considered as potential solutions in meeting these objections and are outlined below.

4.1 Maintain Current Pond

The results of the monitoring program by Calder Engineering Ltd. identifies that the TSS leaving the pond exceeds the Regional sewer by-law during 3 of the 5 severe storm events. With construction occurring along Mayfield Road and Kennedy Road throughout 2015, the high TSS identified for these storms may have been caused by construction sediment transportation. The MOE TSS removal guidelines are intended for anticipated use and do not account for constant construction within the area. It is anticipated that TSS levels will be significantly reduced once the road construction has been finalized.

The high concentrations of Manganese were fairly constant throughout the monitoring period. This may be attributed to the construction equipment within the area. The MOE Stormwater Design Guideline does not specify any limits with regards to Manganese content in stormwater runoff.

The sediment accumulation within the pond has also been identified. Based on the bathometric survey, the sediment forebay has accumulated between 0.2m and 0.3m of sediment. The pond has a surplus of permanent pool volume and the accumulated sediment in the forebay does not exceed the 0.5m recommend in the original report prepared by Stantec Consulting Ltd.; therefore, the pond does not required sediment removal at this time.

In light of the above, the pond performance is in general conformance with the MOE guidelines and is providing adequate stormwater quality controls. While this solution is the most cost effective, it does not address the Region of Peel's concerns with regards to ease of maintenance and the Region's concerns with regards the permit process and high costs associated with the removal of sediment from the forebay.

4.2 Supplemental Treatment Prior to Pond Inlet

One of the options for improving the efficiency of sediment removal from the pond was to provide supplemental treatment of stormwater flows prior to being discharge to the facility. This included the possibility of installing an oil/grit separator manhole on the inlet pipe. There is adequate area within the SWM Facility property to provide such a manhole. Currently, the maintenance path for the facility is located on Kennedy Road and accesses the forebay from the north. A new maintenance path would be required from Mayfield Road to service an oil/grit separator manhole upstream of the pond inlet. It is not recommended to provide infiltration or bioretention treatments prior to the SWM facility, as the sediment would begin to clog these features quickly, resulting in their performance being reduced and replacement required frequently and at great cost.

4.3 Supplemental Treatment at Pond Outfall

In addition to supplemental stormwater treatment at the Facility inlet, supplemental treatment at the pond outlet was also suggested as a possible solution to enhance the quality of stormwater being drained by the Mayfield Road/Kennedy Road storm sewer system. There is limited space between the pond outlet structure and the PSW limits located east of the facility. The discharge location of the outfall is currently located within the PSW setback limits and it isn't recommended that the supplement infrastructure be located in this area. If the infrastructure was located in this area it would disturb the existing wetland vegetation and would also require more frequent maintenance access, which is not desired considering the potential ecological impacts. This would limit the possibilities of supplemental treatment to within the pond banks/maintenance path. Possible solutions for supplemental treatment would be an oil/grit separator manhole, jellyfish filter manhole, or an infiltration gallery. This location is not ideal for infiltration due to the high groundwater elevation from the pond and adjacent wetland. The concern with the oil/grit separator manhole or jellyfish solution is similar to the concerns with regards to maintaining the facility in its current conditions. The majority of sediment will be treated by and accumulate within the SWM Facility prior to being treated by the oil/grit separator manhole at the outfall. The Region of Peel will still have the concerns with regards to ease of maintenance within the pond including the permitting process and high costs associated with the removal of sediment from the forebay.

4.4 SWM Facility Modification

The Region of Peel suggested the use of a new stormwater treatment product to be used within the existing facility. SWM Shield is a submerged concrete box culvert designed to intercept storm sewer discharge at the pond inlet. Stormwater is conveyed over a series of grates on the top of the culvert, slowing the discharge down and allowing the sediment to accumulate within the submerged box culvert. The product is promoted as simulating the performance of the typical sediment forebay required in SWM Wet Pond and Wetland designs. The product is meant to have a maintenance access path constructed adjacent to, and along the length of the culvert to allow for vac-truck access in cleaning out the culvert chambers. The above retrofit scenario would have a high upfront cost associated with the installation of the SWM Shield Product and reconfiguration of the sediment forebay area, but the product would achieve the Region's objective of providing a solution for the cost and ease of future maintenance. Due to the new technology being proposed and limited data about the product available, a monitoring program would be required to ensure proper stormwater treatment is being provided by the facility.

5. Proposed Pond Design

After evaluation of the available options noted is Section 3, and through conversations with the Region of Peel, it was decided that the preferred solution would be the retrofit of the existing facility to include the SWM Shield product. Although there are higher installation costs associated with using the product, the Region of Peel believes the ease of maintenance, the reduction in maintenance costs, and the lengthened service period between pond excavation requirements, provides sufficient benefits to offset the initial cost. The product will be included to supplement the function of a typical forebay. The remainder of the pond will be designed in accordance with the MOE Stormwater Management Plan & Design Guidelines. The parameters of the proposed pond retrofit are explored below.

5.1 Stormwater Management Quality Controls

The original design of the Kennedy SWM Facility was to provide an 'Enhanced Level' of stormwater quality controls for the runoff coming from Mayfield Road and Kennedy Road. The proposed pond is to maintain the 'Enhanced Level' of controls with the proposed facility retrofit. The following Section will outline how the proposed changes to the facility will maintain the Enhance Level of stormwater quality controls.

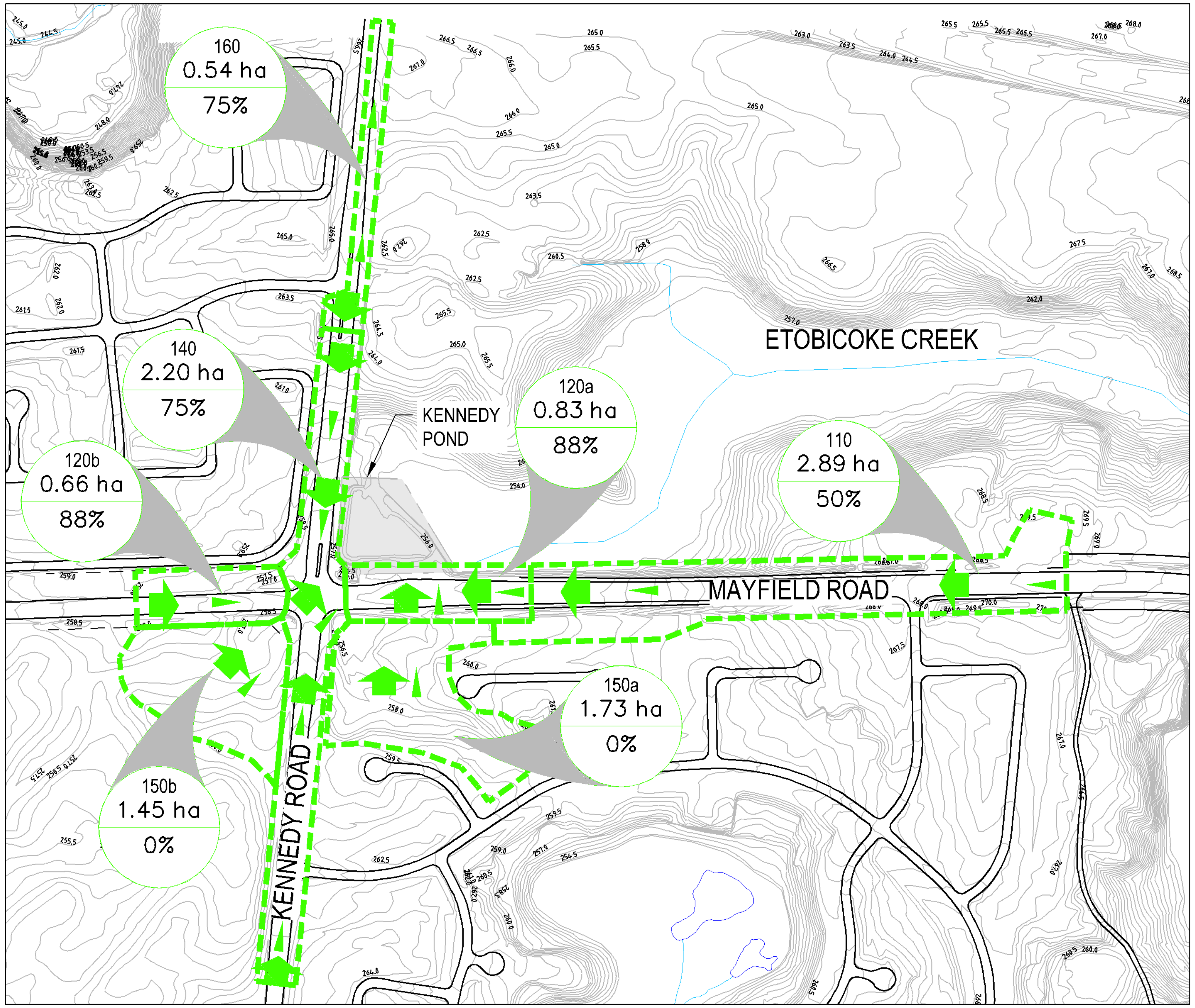
5.1.1 Tributary Area

To appropriately size the SWM Shield product and confirm the facility complies with the MOE Stormwater Management Plan & Design Guidelines, a review of the tributary area contributing drainage to the facility was completed. The original design of the facility accounted for a drainage area of approximately 10.59ha, and a 41% percent ratio of impervious surface. GHD examined the available GIS mapping for the area and examined the Region of Peel plan and profile drawings for Mayfield Road, and established a contributing drainage area for pond sizing of 9.76 ha with an imperious surface ratio of 45%. Tabulated below is a comparison of the pond design parameters for the original drainage area, and proposed drainage area.

Table 5.1 Drainage Area for Pond Volumetric Calculations

Design Scenario	Drainage Area (ha)	Percent Impervious
Original	10.59	41
Proposed	9.76	45

As reported above, it can be seen that the contributing drainage area has changed from the original design of the facility. For comparison, the original drainage scheme prepared by Stantec Consulting Ltd. has been included in the background data(**Appendix F**) and the update drainage scheme by GHD has been attached as Figure 5.1. During the original design, undeveloped areas northwest of the Kennedy and Mayfield intersection drained southeast to the Kennedy SWM Facility. This land has since been developed and no longer contributes drainage to the Kennedy facility. With the acquisition of updated contour mapping, the contributing areas from the agricultural and park lands have been updated as well. Also of note, is the change in contributing drainage from Kennedy



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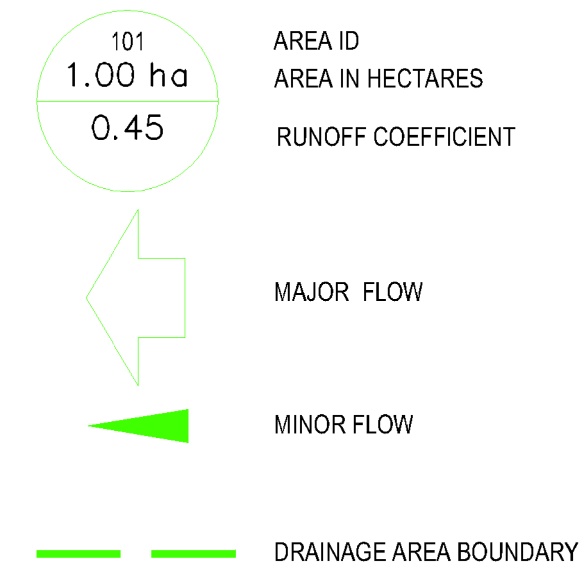

0 50 100 150m
SCALE 1:5000 AT ORIGINAL SIZE

REGION OF PEEL
KENNEDY POND RETROFIT
CITY OF BRAMPTON
TRIBUTARY DRAINAGE AREA

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Revision | A
Date | MAR 2017

Figure 5.1

Road. The Town of Caledon has urbanized Kennedy Road north to the overpass located at Highway No. 410. Although they designed the minor system to take 0.53 ha of drainage west, the major flows from this area continue south, and contribute to the Kennedy SWM Facility. Due to the changes in the drainage area, and the addition of the proposed SWM Shield product changing the geometry and volume characteristics of the pond, the permanent pool within the facility will require a review to ensure the pond volumes maintain compliance with MOE guidelines.

5.1.2 Extended Detention

Having confirmed the SWM Facility's service area, a review was completed to ensure the SWM Facility physical characteristics were in conformance with MOE Criteria. Tabulated below is a comparison of pond storage requirements based on the original design and the new drainage area.

Table 5.2 Pond Volume Requirements

Design Scenario	Drainage Area-Quality Storm (ha)	Percent Impervious	Permanent Pool Requirements		Quality Control Volume (m^3)	Erosion Control Extended Detention Volume*(m^3)
			m^3/ha	Volume(m^3)		
Original Drainage Area	10.59	41	48	508	423	1058
Existing Pond Volumes	-	-	-	860	-	1072
Proposed Drainage Area	9.76	45	52	509	390	1392*
Proposed Pond Volumes	-	-	-	880		1486

- *Refer to calculations in Appendix 'A''

The SWMP Manual states that the extended detention storage is based on the greater of 40m^3/ha or the storage volume required to retain the runoff from the 25 mm storm for 24 to 48 hours. The original design objective of the facility was for a 48 hour drawdown time which will be maintained with the proposed retrofit. The computer program Visual Otthymo 3.0 was utilized in performing the hydrologic modelling of the watershed and establish the recalculated runoff from the 25 mm, 4 hour Chicago rainfall event. The required extended detention storage based on the runoff volume detained for 48 hours was determined to be approximately 1392 m^3 (refer to **Appendix A**). The runoff volume from the erosion control event was found to exceed the quality control objective of 40m^3/ha, therefore the erosion control storage volume of 1392 m^3 will be used in the design of the facility. A copy of the model schematic and the output file are included in **Appendix B**. The hydrologic model is also available in digital format on CD (rear pocket).

The extended detention outflow control device will consist of a 100mm diameter orifice located within a control manhole at the outlet from the facility(MH 1). The orifice will have an invert elevation of 255.55 m and will provide outlet control for the extended detention portion of the total storage.

Drawing 11129100-SWM-202 (rear pocket) shows the control manhole details. This outlet design will provide a detention time of 48 hours, based on a storage volume of approximately 1484 m^3 at a water elevation of 256.15m. Refer to **Appendix A** for the stage-storage-discharge information for the orifice and the detention time calculations. Aggressiveness

5.1.3 Pond Characteristics

The existing facility was constructed as a wetland facility with a 1.5m deep sediment forebay at the southeast limits and 0.3m deep mail cell. The as-built pond characteristics are described below:

- 5:1 slope embankments above the permanent pool elevation(PPE)
- 4:1 slope embankments below the PPE
- PPE of elevation of 255.55m
- PPE volume of 862m^3
- Erosion Control Elevation of 256.00m
- Quality Control/Erosion Control Pool volume of m^3
- 48 hour drawdown time for 25mm storm event
- Hickenbottom outlet structure
- 4:1 pond length to width ratio
- Retaining walls along pond east and west bank
- Geosynthetic Clay liner `
- Construction vehicle access along the north and east banks

The original design of the pond is illustrated on Drawing 41328-D prepared by Stantec Consulting Ltd. and is included with the background information attached in **Appendix F**.

The introduction of the SWM Shield product changes the physical characteristics of the pond. The SWM Shield product essential performs the function of the sediment forebay; however, the continued presence of the forebay is recommended to provide a deep area in which the velocity of the incoming sewer flows can continue to be reduced a further promote the settling of sediment. To accommodate the SWM Shield product, a second pond maintenance path has been introduced from Mayfield Road. The maintenance path will be located along the east pond bank near the inlet headwall. This will allow for access adjacent to the SWMShield product for the regular maintenance.

In addition to the SWM Shield product, there are other modifications to the pond that are proposed to improve the quality control efficiency. It is proposed that the hickenbottom outlet structure be removed and a new outlet structure installed. The stormwater flow control components are proposed to be installed within a maintenance manhole outside the pond, on top of the pond banks. It will allow for easier access for maintenance equipment and personal. A storm sewer headwall will be introduced within the pond to convey flows to a sump within the control manhole. A rock check dam is proposed to surround the outlet sewer to reduce the velocity of the pond flows and help minimize the conveyance of any remaining sediment.

Efforts have been made to maintain the existing characteristics of the wetland main cell and portions of the forebay. This will assist in minimizing disturbance to the existing pond vegetation. The majority of disturbance will occur within the forebay area and the pond outlet structure. The proposed pond characteristics are summarized below:

- 3:1 slope embankments above the permanent pool elevation(PPE)
- 5:1 slope embankments below the PPE
- PPE of elevation of 255.55m
- PPE volume of 880m^3
- Erosion Control Elevation of 256.15m
- Quality Control/Erosion Control Pool volume of 1484m^3
- 48 hour drawdown time for 25mm storm event
- 4:1 Pond length to width ratio
- Outlet headwall with grate and rock check dam
- Retaining walls along pond east and west banks
- Geosynthetic Clay liner
- SWM Shield stormwater quality control product at pond inlet
- New construction vehicle access path at facility south banks
- Construction vehicle access at north banks to remain

The proposed pond layout is illustrated in Drawings 11129100-SWM-201 appended at the end of this report.

5.1.4 SWM Shield

The SWM Shield product is a submerged concrete structure that assists in the reduction in incoming flow velocity. The grates on the structure surface encourage the slowing of flows and settling of sediment into the still waters of the submerged storage tank. Based on the SWM Shield design parameters provided by the product designer, the product is to be sized with 2m^2 of SWM Shield surface area for every hectare of drainage area contributing to the facility(with a 50% impervious coefficient). With approximately 9.76ha of drainage and an impervious ratio of 45%, the required product surface area is approximately 19.5m^2. The proposed unit is to be a 3.0m wide product with a grated section 6.7m long, providing a surface area 20.1m^2. The product depth is to be 2.4m, to allow for increased settlement of sediment and to provide an increased timeframe between maintenance periods. The SWM Shield characteristics are summarized below:

5.2 Stormwater Quantity Controls

The pond currently outfalls to the adjacent wetlands through a gabion basket flow spreader. The gabion basket is located below grade with water rising through the gabion basket and dispersing once the water level reaches the surface. Quantity control objectives were established by Stantec

Consulting Ltd. that the discharge from the Kennedy SWM facility was to be control to pre-development conditions for the 2 though 100 year storm event. Tabulated below are the pre-development peak flow design objectives as established in the original design:

Table 5.3 Original Peak Flows

Return Period Storm Event(yr)	Peak Flow(m^3/s)
2	0.25
5	0.44
10	0.58
25	0.77
50	0.92
100	1.07
Regional	1.44

To provide the required quantity controls, a control weir is proposed in the control manhole. The control weir will act in addition to the 100mm quality control orifice specified in Section 4.1.2. The base of the proposed weir will be set at the extended detention elevation of 259.55m established as part of the quality control objectives. The control weir will have a width of 0.35m and allow for the release of stormwater for minor storm events which exceed the 25mm storm. The limited space available to construct the original pond restricted the ability to control post-development flows within the minor sewer discharge system. An embankment control weir was designed as part of the original pond for more severe storm events, as opposed to the more typical use as an emergency overflow spillway. The area constraints remain for the proposed design and the embankment weir will continue to be used. The combination of the 3 control structures will support a gradual increase in the discharge from the pond and will limit the post-development peak flows to the pre-development levels.

The computer program Visual Otthymo 3.0 was used to simulate the tributary drainage areas and attenuation characteristics of the facility. The STANDHYD subroutine was used to simulate the urban drainage areas contributing to the stormwater facility and the NASHYD subroutine to simulate the rural fields bypassing the pond. The ROUTE RESERVOIR subroutine was used to simulate the performance of the control structures and the attenuation volume of the pond Tabulated below is a comparison of the pre-development peak flows and new peak flows from the revised quantity controls configuration..

Table 5.4 Proposed Peak Flows

Return Period Storm Event(yr)	Original Pre-Development Peak Flows(m^3/s)	Revised Peak Flows(m^3/s)	Attenuation Volume(m^3)	Pond Water Surface Elevation(m)
2	0.25	0.04	1821	256.27
5	0.44	0.17	2147	256.38
10	0.58	0.29	2272	256.40
25	0.77	0.44	2429	256.45
50	0.92	0.57	2535	256.49

Table 5.4 Proposed Peak Flows

Return Period Storm Event(yr)	Original Pre-Development Peak Flows(m^3/s)	Revised Peak Flows(m^3/s)	Attenuation Volume(m^3)	Pond Water Surface Elevation(m)
100	1.07	0.74	2677	256.53

As reported above, the post-development peak flows for the proposed pond retrofit are below the pre-development levels; therefore, no adverse effect is anticipated from the proposed pond retrofit. Details for the revised outfall structures are illustrated on drawings 11129100-SWM-202, attached at the end of this report.

6. Landscaping

The existing vegetation included within the facility is consistent with the original design. It was evident that Typha plants had moved into the facility and occupied much of the pond shoreline. The proposed facility retrofit will introduce more maintenance pathway and disturb the eastern and west pond banks. It is proposed that areas disturb for grading be restored with similar plan species. An ecological review of the ponds was completed as part of the pond review and found that there is no significant plant or wildlife species within the facility and there should be no issues with the proposed retrofit. A Ecological Impact Memo has been completed and parameters have been specified to minimize impact as the local wildlife. The Ecological Impact memo is included in **Appendix D**.

7. Temporary Erosion and Sediment Controls

During the construction process, the removal of vegetation and moving of dirt was the potential to transport sediment downstream. Temporary sediment controls will be put in place to assist in preventing the transportation of sediment. Typical erosion and sediment control methods will be implemented around the work site. This would include such items as the installation of perimeter enviro fence around the work area, installation of silt sacs on local catchbasins, the use of a construction vehicle mudmat for site access, and the inclusion of a dust control/street sweeping program. Another control feature also proposed is a temporary bulkhead within the outfall manhole. The construction process will also be examined to determine an efficient means to provide controls. The temporary erosion control details and notes are included on the Erosion and Sediment Control Plan, Dwg 11129100-ES-201, attached at the end of this report.

8. Maintenance

As with all end of pipe SWM solutions, the wetland facility requires maintenance to ensure continued performance and sediment removal rates. Although the SWM Shield product has been included within the facility, there will be continued maintenance procedures which will be required for the facility. A maintenance manual has been provided in **Appendix E**, outlining the various items that will require attention, the frequency in which they should be attended, and estimated costs. Maintenance requires for the SWM Shield product are also included within the manual.

9. Conclusions

The above report examined the existing Kennedy Wetland Stormwater Management Facility to determine if the pond is providing adequate stormwater quality controls, and whether the pond can be updated to provide a more efficient means of maintenance. Based on the information provided, it appears the pond is providing adequate stormwater quality controls in conformance with the MOE Stormwater Management Guidelines; however, more suitable options are available to improve the efficiency of pond maintenance. The investigation resulted in a new pond layout to allow for the Region of Peel to have a more proficient means of access in the removal of sediment and maintenance of infrastructure. The findings of the study are summarized as follows:

- The redesigned pond will provide a permanent pool volume in accordance with MOE requirements for an 'Enhanced' level of stormwater quality control;
- The runoff from the 25mm rainfall event will be detained within the SWM facility for a minimum of 48 hours to provide extended detention control;
- The SWM Shield product will be installed to complement the sediment forebay, a high percentage of sediment entering the facility;
- A relocated outfall structure will allow for ease of access to the pond control infrastructure
- The retrofit works were limited to the forebay and outlet of the pond to help minimize disturbance to established plant life;
- A maintenance manual has been provided to assist the Region of Peel in establishing the frequency and costs to sustain the facility

We trust the above review and recommendations of the Region of Peel's existing Kennedy Stormwater Management Facility is sufficient for the Region of Peel to move forward with the construction of the proposed infrastructure improvements. Should there be any questions with regards to this review, please contact our office.

Respectfully submitted,
GHD

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Appendices

Appendix A
SWM Facility Sizing Calculations

CALCULATIONS

Prepared by SS
Checked by JI

Project Name	KENNEDY POND RETROFIT
Project No.	11129100
Subject	Permanent Pool Volume Calculation

ID	DESCRIPTION	AREA	% IMPERV	AC
110	Mayfield - East of Pond	2.89	50%	1.445
120	Mayfield - Road	1.49	88%	1.3112
140	Kennedy Road	2.2	75%	1.65
150	SE Subdivision & Agricultural	3.18	0%	0
	Total	9.76	45%	4.4062

* Drainage from Major System Only

Criteria: 80% T.S.S Removal

Area: 9.76 ha

Imperviousness: 45%

Permanent Pool Volume[1] = $(92m^3/ha - 40\ m^3/ha) \times Area$

= 509 m^3

[1] As per the Stormwater Management Planning and Design Manual, Ministry of the Environment, March 2003

CALCULATIONS

Prepared by SS
Checked by JI

Project Name	KENNEDY POND RETROFIT
Project No.	11129100
Subject	Extended Detention Calculations

ID	DESCRIPTION	AREA	% IMPERV	AC
110	Mayfield - East of Pond	2.89	50%	1.445
120	Mayfield - Road	1.49	88%	1.3112
140	Kennedy Road	2.2	75%	1.65
150	SE Subdivision & Agricultural	3.18	0%	0
130*	Pond	0.53	35%	0.1855
160**	Kenendy Road	0.54	75%	0.405
	Total	10.83	46%	4.9967

*Pond drainage area not included in quality control

**Major Flow Only

Criteria: 25mm event over 48 hours

Area: 10.83 ha Site Area (From Visual Otthymo)

Runoff Volume = 13.53 mm (From Visual Otthymo)

= 135.3 m^3 /ha

Ext. Det. Volume = Runoff Volume x Area

= 1465 m^3

Qpeak = Ext. Det Volume / Duration

Qpeak(24h) = 0.017 m^3/s

CALCULATIONS

Prepared by SS
Checked by JI

Project Name	KENNEDY POND RETROFIT
Project No.	11129100
Subject	SWM Facility Stage-Volume Information

Depth Increment (m)	0.05
Perm. Pool Vol. Req'd (m^3)	509
Permanent Pool Elevation (m)	255.55
Permanent Pool Vol. (m^3)	880.42
Bottom of Main Cell (m)	255.25
Permanent Pool Depth (m)	0.30
Bottom of Pond (m)	254.00
Max. Pond Elevation (m)	256.90
Max Active Storage (m^3)	3876

Elevation (m)	Depth (m)	Surface Area (m^2)	Incr. Area (m^2)
254.00	0	104	7.4
254.25	0.3	141	8.6
254.50	0.5	184	9.6
254.75	0.8	232	13.6
255.00	1.0	300	196.2
255.25	1.3	1281	120.8
255.55	1.6	2006	100.0
255.70	1.7	2306	60.6
256.00	2.0	2670	72.1
256.50	2.5	3391	85.1
256.90	2.9	4072	85.1

Elevation (m)	Depth (m)	Area (m^2)	Incr. Volume (m^3)	Cum. Volume (m^3)	Ext. Det. Volume (m^3)	Storage Volume (m^3)
254.00		104				
254.05	0.05	111	5	5		
254.10	0.10	119	6	11		
254.15	0.15	126	6	17		
254.20	0.20	134	6	24		
254.25	0.25	141	7	31		
254.30	0.30	150	7	38		
254.35	0.35	158	8	46		
254.40	0.40	167	8	54		
254.45	0.45	175	9	62		
254.50	0.50	184	9	71		
254.55	0.55	194	9	81		
254.60	0.60	203	10	91		
254.65	0.65	213	10	101		
254.70	0.70	222	11	112		
254.75	0.75	232	11	123		
254.80	0.80	246	12	135		
254.85	0.85	259	13	148		
254.90	0.90	273	13	161		
254.95	0.95	286	14	175		
255.00	1.00	300	15	190		
255.05	1.05	496	20	210		
255.10	1.10	692	30	239		
255.15	1.15	889	40	279		
255.20	1.20	1085	49	328		
255.25	1.25	1281	59	387		

255.30	1.30	1402	67	454		
255.35	1.35	1523	73	528		
255.40	1.40	1643	79	607		
255.45	1.45	1764	85	692		
255.50	1.50	1885	91	783		
255.55	1.55	2006	97	880		
255.60	1.60	2106	103	983	103	
255.65	1.65	2206	108	1091	211	
255.70	1.70	2306	113	1204	323	
255.75	1.75	2367	117	1321	440	
255.80	1.80	2427	120	1440	560	
255.85	1.85	2488	123	1563	683	
255.90	1.90	2548	126	1689	809	
255.95	1.95	2609	129	1818	938	
256.00	2.00	2670	132	1950	1070	
256.05	2.05	2742	135	2085	1205	
256.10	2.10	2814	139	2224	1344	
256.15	2.15	2886	143	2367	1486	21
256.20	2.20	2958	146	2513	1633	167
256.25	2.25	3030	150	2663	1782	317
256.30	2.30	3102	153	2816	1936	470
256.35	2.35	3175	157	2973	2093	627
256.40	2.40	3247	161	3133	2253	788
256.45	2.45	3319	164	3298	2417	952
256.50	2.50	3391	168	3465	2585	1120
256.55	2.55	3476	172	3637	2757	1291
256.60	2.60	3561	176	3813	2933	1467
256.65	2.65	3646	180	3993	3113	1647
256.70	2.70	3732	184	4178	3297	1832
256.75	2.75	3817	189	4366	3486	2021
256.80	2.80	3902	193	4559	3679	2214
256.85	2.85	3987	197	4756	3876	2411
256.90	2.90	4072	201	4958	4078	2612

GHD

CALCULATIONS

Prepared by SS
Checked by JI

Project Name	KENNEDY POND RETROFIT
Project No.	11129100
Subject	Outlet Design

Incremental Depth(m) =	0.05

Orifice: $Q=CA(2gH)^{0.5}$		
	Orifice 1	Orifice 2
Contraction coeff, C=	0.62	0.62
Orifice Diameter (mm) =	100.0	
Area of Orifice(m^2), A=	0.0079	
Horizontal Orifice (y/n)	n	n
Invert 1 (m) =	255.55	
N.W.L./Inlet Elevation (m) =	255.55	

Weir: Q=2/3*Cd*(2*g)^0.5*L*H^3/2		
	Weir 1	Weir 2
Length (m)=	0.35	3.00
Coef.C_d =	0.62	0.62
Rect'lr (y/n) =	y	y
Crest Hght (m)=	0.60	0.60
Crest EL (m)=	256.15	256.30

Extended Detention	
Volume Required (m^3) =	1465
Detention Time (hr)=	55
Depth (m)=	0.60
EL (m)=	256.15
Max.Qrel (m^3/s)=	0.016
Volume Available(m^3)=	1486

Water Elevation (m)	Depth (m)	Head 1 (m)	Orifice 1 Q (l/s)	Head 2 (m)	Orifice 2 Q (l/s)	Weir 1 Q (m^3/s)	Weir 2 Q (m^3/s)	Total Q (m^3/s)	Total Storage (m^3)
255.55									
255.60	0.05								103
255.65	0.10	0.05	4.82					0.005	211
255.70	0.15	0.10	6.82					0.007	323
255.75	0.20	0.15	8.35					0.008	440
255.80	0.25	0.20	9.65					0.010	560
255.85	0.30	0.25	10.78					0.011	683
255.90	0.35	0.30	11.81					0.012	809
255.95	0.40	0.35	12.76					0.013	938
256.00	0.45	0.40	13.64					0.014	1070
256.05	0.50	0.45	14.47					0.014	1205
256.10	0.55	0.50	15.25					0.015	1344
256.15	0.60	0.55	16.00					0.016	1486
256.20	0.65	0.60	16.71			0.005		0.022	1633
256.25	0.70	0.65	17.39			0.015		0.032	1782
256.30	0.75	0.70	18.05			0.029		0.047	1936
256.35	0.80	0.75	18.68			0.045	0.061	0.125	2093
256.40	0.85	0.80	19.29			0.064	0.174	0.257	2253
256.45	0.90	0.85	19.89			0.085	0.319	0.424	2417
256.50	0.95	0.90	20.46			0.109	0.491	0.620	2585
256.55	1.00	0.95	21.02			0.134	0.686	0.841	2757
256.60	1.05	1.00	21.57			0.161	0.902	1.085	2933
256.65	1.10	1.05	22.10			0.190	1.137	1.349	3113
256.70	1.15	1.10	22.62			0.221	1.389	1.633	3297
256.75	1.20	1.15	23.13			0.254	1.657	1.934	3486
256.80	1.25	1.20	23.63			0.288	1.941	2.253	3679
256.85	1.30	1.25	24.11			0.324	2.239	2.588	3876
256.90	1.35	1.30	24.59			0.362	2.552	2.938	4078

CALCULATIONS

Prepared by SS
Checked by JI

Project Name	KENNEDY POND RETROFIT
Project No.	11129100
Subject	Detention Time

Equation 4.10 SWM Planning & Design Manual (MOE, 2003)

Drawdown Time = $t = 2 A_p(h_1^{0.5} - h_2^{0.5})/(C A_0 (2g)^{0.5})$

where,	C =	dishcarge coefficient=	0.62
	h_1 =	starting water elevation above the orifice(m)	0.55
	h_2=	ending water elevation above the orifice(m)	0.00
	A_o =	cross sectional area of orifice =	0.0079
	A_p =	surface area of pond(m^2)	2886

t = 198468 s

t = 55 hr

Date: 5/23/2017
File Location: G:\111\11129100\Technical\Water Resources\Spreadsheets\111-29100 - Outlet Design-Kennedy Rev May 20171[Drawdown]

Appendix B
Visual Otthymo Output Files

```
================================================================================================

       V    V   I    SSSSS  U   U    A    L
       V    V   I    SS     U   U   A A   L
        V  V    I     SS    U   U  AAAAA  L
        V  V    I      SS   U   U  A   A  L
         VV     I    SSSSS  UUUUU  A   A  LLLLL

        OOO   TTTTT  TTTTT  H   H  Y   Y  M   M   OOO     TM
       O   O    T      T    H   H   Y Y   MM MM  O   O
       O   O    T      T    H   H    Y    M   M  O   O
        OOO     T      T    H   H    Y    M   M   OOO
```

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***** D E T A I L E D   O U T P U T *****

Input   filename: C:\Program Files (x86)\VH Suite 3.0\VO2\voin.dat
Output filename: C:\Users\jiantomasi\AppData\Local\Temp\0ca6545a-89e5-4cbd-9772-39d4c2518c8e\Scenario.out
Summary filename: C:\Users\jiantomasi\AppData\Local\Temp\0ca6545a-89e5-4cbd-9772-39d4c2518c8e\Scenario.sum

DATE: 05/24/2017   TIME: 08:01:48

USER:

COMMENTS: ____

```
------------------------------------------------------------------------------------------------
  ****************************
  ** SIMULATION NUMBER:   1 **
  ****************************

--------------------
|    READ STORM    |    Filename: C:\Users\jiantomasi\AppD
|                  |              ata\Local\Temp\
|                  |              0ca6545a-89e5-4cbd-9772-39d4c2518c8e\14a167bf
| Ptotal= 36.00 mm |    Comments: Toronto Bloor: 6-hr, 2-yr storm
--------------------
```

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.25	0.72	1.75	12.24	3.25	5.04	4.75	0.72
0.50	0.72	2.00	12.24	3.50	5.04	5.00	0.72
0.75	0.72	2.25	33.12	3.75	2.88	5.25	0.72
1.00	0.72	2.50	33.12	4.00	2.88	5.50	0.72
1.25	4.32	2.75	9.36	4.25	1.44	5.75	0.72
1.50	4.32	3.00	9.36	4.50	1.44	6.00	0.72

```
--------------------------------------------------------------------------------

--------------------
| CALIB            |
| NASHYD    (0150) |   Area    (ha)=   3.18   Curve Number   (CN)= 75.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   1.50   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.56

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.
```

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.083	0.72	1.583	12.24	3.083	5.04	4.58	0.72
0.167	0.72	1.667	12.24	3.167	5.04	4.67	0.72
0.250	0.72	1.750	12.24	3.250	5.04	4.75	0.72
0.333	0.72	1.833	12.24	3.333	5.04	4.83	0.72
0.417	0.72	1.917	12.24	3.417	5.04	4.92	0.72
0.500	0.72	2.000	12.24	3.500	5.04	5.00	0.72
0.583	0.72	2.083	33.12	3.583	2.88	5.08	0.72
0.667	0.72	2.167	33.12	3.667	2.88	5.17	0.72
0.750	0.72	2.250	33.12	3.750	2.88	5.25	0.72
0.833	0.72	2.333	33.12	3.833	2.88	5.33	0.72
0.917	0.72	2.417	33.12	3.917	2.88	5.42	0.72
1.000	0.72	2.500	33.12	4.000	2.88	5.50	0.72
1.083	4.32	2.583	9.36	4.083	1.44	5.58	0.72
1.167	4.32	2.667	9.36	4.167	1.44	5.67	0.72
1.250	4.32	2.750	9.36	4.250	1.44	5.75	0.72

```
              1.333    4.32 | 2.833    9.36 | 4.333    1.44 |  5.83    0.72
              1.417    4.32 | 2.917    9.36 | 4.417    1.44 |  5.92    0.72
              1.500    4.32 | 3.000    9.36 | 4.500    1.44 |  6.00    0.72

     Unit Hyd Qpeak  (cms)=   0.217

     PEAK FLOW       (cms)=   0.048 (i)
     TIME TO PEAK    (hrs)=   3.000
     RUNOFF VOLUME    (mm)=   9.987
     TOTAL RAINFALL   (mm)=  36.000
     RUNOFF COEFFICIENT   =   0.277

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB             |
| STANDHYD  (0110) |   Area    (ha)=   2.89
|ID= 1 DT= 5.0 min |   Total Imp(%)=  50.00   Dir. Conn.(%)=  50.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       1.45          1.45
     Dep. Storage     (mm)=       1.00          1.50
     Average Slope     (%)=       2.00          2.00
     Length            (m)=     138.80         40.00
     Mannings n           =      0.013         0.250

     Max.Eff.Inten.(mm/hr)=      33.12         10.77
                over (min)        5.00         25.00
     Storage Coeff.  (min)=       3.93 (ii)    21.14 (ii)
     Unit Hyd. Tpeak (min)=       5.00         25.00
     Unit Hyd. peak  (cms)=       0.24          0.05
                                                             *TOTALS*
     PEAK FLOW       (cms)=       0.13          0.03           0.154 (iii)
     TIME TO PEAK    (hrs)=       2.50          2.75            2.50
     RUNOFF VOLUME    (mm)=      35.00          9.99           22.49
     TOTAL RAINFALL   (mm)=      36.00         36.00           36.00
     RUNOFF COEFFICIENT   =       0.97          0.28            0.62

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB             |
| STANDHYD  (0120) |   Area    (ha)=   1.49
|ID= 1 DT= 5.0 min |   Total Imp(%)=  88.00   Dir. Conn.(%)=  88.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       1.31          0.18
     Dep. Storage     (mm)=       1.00          1.50
     Average Slope     (%)=       2.00          1.00
     Length            (m)=      99.67         40.00
     Mannings n           =      0.013         0.250

     Max.Eff.Inten.(mm/hr)=      33.12         10.12
                over (min)        5.00         25.00
     Storage Coeff.  (min)=       3.22 (ii)    24.95 (ii)
     Unit Hyd. Tpeak (min)=       5.00         25.00
     Unit Hyd. peak  (cms)=       0.27          0.05
                                                             *TOTALS*
     PEAK FLOW       (cms)=       0.12          0.00           0.123 (iii)
     TIME TO PEAK    (hrs)=       2.50          2.75            2.50
     RUNOFF VOLUME    (mm)=      35.00          9.99           31.99
     TOTAL RAINFALL   (mm)=      36.00         36.00           36.00
     RUNOFF COEFFICIENT   =       0.97          0.28            0.89

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB             |
| STANDHYD  (0130) |   Area    (ha)=   0.53
```

```
|ID= 1 DT= 5.0 min |   Total Imp(%)=  35.00   Dir. Conn.(%)=  35.00
--------------------
                                IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        0.19          0.34
     Dep. Storage     (mm)=        1.00          1.50
     Average Slope     (%)=        1.00          1.00
     Length            (m)=       59.44         40.00
     Mannings n           =       0.013         0.250

     Max.Eff.Inten.(mm/hr)=       33.12         10.12
                over (min)         5.00         25.00
     Storage Coeff.  (min)=        2.91 (ii)    24.63 (ii)
     Unit Hyd. Tpeak (min)=        5.00         25.00
     Unit Hyd. peak  (cms)=        0.28          0.05
                                                            *TOTALS*
     PEAK FLOW       (cms)=        0.02          0.01          0.022 (iii)
     TIME TO PEAK    (hrs)=        2.50          2.75           2.50
     RUNOFF VOLUME    (mm)=       35.00          9.99          18.71
     TOTAL RAINFALL   (mm)=       36.00         36.00          36.00
     RUNOFF COEFFICIENT   =        0.97          0.28           0.52

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB             |
| STANDHYD  (0140) |   Area    (ha)=   2.20
|ID= 1 DT= 5.0 min |   Total Imp(%)=  75.00   Dir. Conn.(%)=  75.00
--------------------
                                IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        1.65          0.55
     Dep. Storage     (mm)=        1.00          1.50
     Average Slope     (%)=        2.00          2.00
     Length            (m)=      121.11         40.00
     Mannings n           =       0.013         0.250

     Max.Eff.Inten.(mm/hr)=       33.12         10.77
                over (min)         5.00         25.00
     Storage Coeff.  (min)=        3.62 (ii)    20.83 (ii)
     Unit Hyd. Tpeak (min)=        5.00         25.00
     Unit Hyd. peak  (cms)=        0.25          0.05
                                                            *TOTALS*
     PEAK FLOW       (cms)=        0.15          0.01          0.160 (iii)
     TIME TO PEAK    (hrs)=        2.50          2.75           2.50
     RUNOFF VOLUME    (mm)=       35.00          9.99          28.74
     TOTAL RAINFALL   (mm)=       36.00         36.00          36.00
     RUNOFF COEFFICIENT   =        0.97          0.28           0.80

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB             |
| STANDHYD  (0160) |   Area    (ha)=   0.54
|ID= 1 DT= 5.0 min |   Total Imp(%)=  75.00   Dir. Conn.(%)=  75.00
--------------------
                                IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        0.41          0.14
     Dep. Storage     (mm)=        1.00          1.50
     Average Slope     (%)=        2.00          2.00
     Length            (m)=       60.00         40.00
     Mannings n           =       0.013         0.250

     Max.Eff.Inten.(mm/hr)=       33.12         10.77
                over (min)         5.00         20.00
     Storage Coeff.  (min)=        2.38 (ii)    19.59 (ii)
     Unit Hyd. Tpeak (min)=        5.00         20.00
     Unit Hyd. peak  (cms)=        0.30          0.06
                                                            *TOTALS*
     PEAK FLOW       (cms)=        0.04          0.00          0.040 (iii)
     TIME TO PEAK    (hrs)=        2.50          2.67           2.50
     RUNOFF VOLUME    (mm)=       35.00          9.99          28.73
```

```
     TOTAL RAINFALL   (mm)=      36.00        36.00           36.00
     RUNOFF COEFFICIENT   =       0.97         0.28            0.80

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| DUHYD     (0010) |
| Inlet Cap.=0.054 |
| #of Inlets=    1 |
| Total(cms)=  0.1 |      AREA     QPEAK     TPEAK    R.V.
--------------------      (ha)     (cms)     (hrs)    (mm)
     TOTAL HYD.(ID= 1):   0.54      0.04      2.50   28.73
     ==================================================
     MAJOR SYS.(ID= 2):   0.00      0.00      0.00    0.00
     MINOR SYS.(ID= 3):   0.54      0.04      2.50   28.73

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------

--------------------
| ADD HYD   (0005) |
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
*** W A R N I N G :  HYDROGRAPH 0010 <ID= 1> IS DRY.
*** W A R N I N G :  HYDROGRAPH 0005 = HYDROGRAPH 0110
*** W A R N I N G :  HYDROGRAPH 0005 = HYDROGRAPH 0110
          ID1= 1 (0010):     0.00   0.000     0.00     0.00
        + ID2= 2 (0110):     2.89   0.154     2.50    22.49
          ==================================================
          ID = 3 (0005):     2.89   0.154     2.50    22.49

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------

--------------------
| ADD HYD   (0005) |
|   3 +  2 =  1    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
          ID1= 3 (0005):     2.89   0.154     2.50    22.49
        + ID2= 2 (0120):     1.49   0.123     2.50    31.99
          ==================================================
          ID = 1 (0005):     4.38   0.277     2.50    25.72

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------

--------------------
| ADD HYD   (0005) |
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
          ID1= 1 (0005):     4.38   0.277     2.50    25.72
        + ID2= 2 (0130):     0.53   0.022     2.50    18.71
          ==================================================
          ID = 3 (0005):     4.91   0.299     2.50    24.96

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------

--------------------
| ADD HYD   (0005) |
|   3 +  2 =  1    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
          ID1= 3 (0005):     4.91   0.299     2.50    24.96
        + ID2= 2 (0140):     2.20   0.160     2.50    28.74
          ==================================================
          ID = 1 (0005):     7.11   0.459     2.50    26.13

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------

--------------------
| ADD HYD   (0005) |
```

```
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
          ID1= 1 (0005):     7.11   0.459     2.50    26.13
        + ID2= 2 (0150):     3.18   0.048     3.00     9.99
          ==================================================
          ID = 3 (0005):    10.29   0.486     2.50    21.14

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR (0006) |
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |   0.0320      0.1782
                          0.0050     0.0211   |   0.1250      0.2093
                          0.0080     0.0440   |   0.4240      0.2417
                          0.0110     0.0683   |   0.8410      0.2757
                          0.0130     0.0938   |   1.3500      0.3113
                          0.0140     0.1205   |   1.9300      0.3486
                          0.0160     0.1486   |   2.5900      0.3876

                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 2 (0005)     10.290      0.486      2.50      21.14
     OUTFLOW: ID= 1 (0006)     10.290      0.044      4.42      21.04

                    PEAK   FLOW   REDUCTION [Qout/Qin](%)=  8.96
                    TIME SHIFT OF PEAK FLOW         (min)=115.00
                    MAXIMUM  STORAGE   USED       (ha.m.)=  0.1821

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD  (0011) |   Area    (ha)=   0.00
|ID= 1 DT= 5.0 min |   Total Imp(%)=  50.00   Dir. Conn.(%)=  35.00
--------------------
                               IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       0.00         0.00
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=       0.00        40.00
     Mannings n          =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=      33.12        24.32
                over (min)        5.00        15.00
     Storage Coeff.  (min)=       0.00 (ii)   12.42 (ii)
     Unit Hyd. Tpeak (min)=       5.00        15.00
     Unit Hyd. peak  (cms)=       0.34         0.13
                                                             *TOTALS*
     PEAK FLOW       (cms)=       0.00         0.00           0.000 (iii)
     TIME TO PEAK    (hrs)=       0.00         0.00           0.00
     RUNOFF VOLUME    (mm)=    NaN          NaN            NaN
     TOTAL RAINFALL   (mm)=      36.00        36.00          36.00
     RUNOFF COEFFICIENT   =    NaN          NaN            NaN

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 50.00          K  (1/hr)=  2.00
            Fc   (mm/hr)=  7.50     Cum.Inf.   (mm)=  0.00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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--------------------
| ADD HYD   (0012) |
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
*** W A R N I N G :  HYDROGRAPH 0011 <ID= 2> IS DRY.
*** W A R N I N G :  HYDROGRAPH 0003 = HYDROGRAPH 0001
*** W A R N I N G :  HYDROGRAPH 0003 = HYDROGRAPH 0001
          ID1= 1 (0010):     0.54   0.040     2.50    28.73
        + ID2= 2 (0011):     0.00   0.000     0.00   NaN
          ==================================================
          ID = 3 (0012):     0.54   0.040     2.50    28.73

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

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  ****************************
```

```
  ** SIMULATION NUMBER:   2 **
  ****************************


--------------------
|    READ STORM    |    Filename: C:\Users\jiantomasi\AppD
|                  |              ata\Local\Temp\
|                  |              0ca6545a-89e5-4cbd-9772-39d4c2518c8e\7bba34cc
| Ptotal= 47.80 mm |    Comments: Toronto Bloor: 6-hr, 5-yr storm
--------------------
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                 0.25    0.96 | 1.75    16.25 |  3.25    6.69 |  4.75    0.96
                 0.50    0.96 | 2.00    16.25 |  3.50    6.69 |  5.00    0.96
                 0.75    0.96 | 2.25    43.98 |  3.75    3.82 |  5.25    0.96
                 1.00    0.96 | 2.50    43.98 |  4.00    3.82 |  5.50    0.96
                 1.25    5.74 | 2.75    12.43 |  4.25    1.91 |  5.75    0.96
                 1.50    5.74 | 3.00    12.43 |  4.50    1.91 |  6.00    0.96

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--------------------
| CALIB            |
| NASHYD    (0150) |   Area    (ha)=   3.18   Curve Number   (CN)= 75.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   1.50   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.56

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                                  ---- TRANSFORMED HYETOGRAPH ----
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.083    0.96 | 1.583   16.25 | 3.083    6.69 |  4.58    0.96
                0.167    0.96 | 1.667   16.25 | 3.167    6.69 |  4.67    0.96
                0.250    0.96 | 1.750   16.25 | 3.250    6.69 |  4.75    0.96
                0.333    0.96 | 1.833   16.25 | 3.333    6.69 |  4.83    0.96
                0.417    0.96 | 1.917   16.25 | 3.417    6.69 |  4.92    0.96
                0.500    0.96 | 2.000   16.25 | 3.500    6.69 |  5.00    0.96
                0.583    0.96 | 2.083   43.98 | 3.583    3.82 |  5.08    0.96
                0.667    0.96 | 2.167   43.98 | 3.667    3.82 |  5.17    0.96
                0.750    0.96 | 2.250   43.98 | 3.750    3.82 |  5.25    0.96
                0.833    0.96 | 2.333   43.98 | 3.833    3.82 |  5.33    0.96
                0.917    0.96 | 2.417   43.98 | 3.917    3.82 |  5.42    0.96
                1.000    0.96 | 2.500   43.98 | 4.000    3.82 |  5.50    0.96
                1.083    5.74 | 2.583   12.43 | 4.083    1.91 |  5.58    0.96
                1.167    5.74 | 2.667   12.43 | 4.167    1.91 |  5.67    0.96
                1.250    5.74 | 2.750   12.43 | 4.250    1.91 |  5.75    0.96
                1.333    5.74 | 2.833   12.43 | 4.333    1.91 |  5.83    0.96
                1.417    5.74 | 2.917   12.43 | 4.417    1.91 |  5.92    0.96
                1.500    5.74 | 3.000   12.43 | 4.500    1.91 |  6.00    0.96

     Unit Hyd Qpeak  (cms)=   0.217

     PEAK FLOW       (cms)=   0.080 (i)
     TIME TO PEAK    (hrs)=   3.000
     RUNOFF VOLUME    (mm)=  16.369
     TOTAL RAINFALL   (mm)=  47.802
     RUNOFF COEFFICIENT   =   0.342

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD  (0110) |   Area    (ha)=   2.89
|ID= 1 DT= 5.0 min |   Total Imp(%)=  50.00   Dir. Conn.(%)=  50.00
--------------------
                               IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       1.45          1.45
     Dep. Storage     (mm)=       1.00          1.50
     Average Slope     (%)=       2.00          2.00
     Length            (m)=     138.80         40.00
     Mannings n           =      0.013         0.250

     Max.Eff.Inten.(mm/hr)=      43.98         18.61
                over (min)        5.00         20.00
     Storage Coeff.  (min)=       3.51 (ii)    17.34 (ii)
     Unit Hyd. Tpeak (min)=       5.00         20.00
     Unit Hyd. peak  (cms)=       0.26          0.06
                                                            *TOTALS*
     PEAK FLOW       (cms)=       0.18          0.05          0.221 (iii)
     TIME TO PEAK    (hrs)=       2.50          2.67           2.50
     RUNOFF VOLUME    (mm)=      46.80         16.37          31.58
```

```
     TOTAL RAINFALL   (mm)=      47.80        47.80           47.80
     RUNOFF COEFFICIENT   =       0.98         0.34            0.66

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB              |
| STANDHYD  (0120) |   Area    (ha)=   1.49
|ID= 1 DT= 5.0 min |   Total Imp(%)=  88.00   Dir. Conn.(%)=  88.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       1.31         0.18
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       2.00         1.00
     Length            (m)=      99.67        40.00
     Mannings n           =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=      43.98        17.70
                over (min)        5.00        25.00
     Storage Coeff.  (min)=       2.88 (ii)   20.25 (ii)
     Unit Hyd. Tpeak (min)=       5.00        25.00
     Unit Hyd. peak  (cms)=       0.28         0.05
                                                            *TOTALS*
     PEAK FLOW       (cms)=       0.16         0.01           0.165 (iii)
     TIME TO PEAK    (hrs)=       2.50         2.75            2.50
     RUNOFF VOLUME    (mm)=      46.80        16.37           43.14
     TOTAL RAINFALL   (mm)=      47.80        47.80           47.80
     RUNOFF COEFFICIENT   =       0.98         0.34            0.90

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB              |
| STANDHYD  (0130) |   Area    (ha)=   0.53
|ID= 1 DT= 5.0 min |   Total Imp(%)=  35.00   Dir. Conn.(%)=  35.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       0.19         0.34
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         1.00
     Length            (m)=      59.44        40.00
     Mannings n           =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=      43.98        17.70
                over (min)        5.00        20.00
     Storage Coeff.  (min)=       2.60 (ii)   19.97 (ii)
     Unit Hyd. Tpeak (min)=       5.00        20.00
     Unit Hyd. peak  (cms)=       0.29         0.06
                                                            *TOTALS*
     PEAK FLOW       (cms)=       0.02         0.01           0.033 (iii)
     TIME TO PEAK    (hrs)=       2.50         2.67            2.50
     RUNOFF VOLUME    (mm)=      46.80        16.37           27.00
     TOTAL RAINFALL   (mm)=      47.80        47.80           47.80
     RUNOFF COEFFICIENT   =       0.98         0.34            0.56

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB              |
| STANDHYD  (0140) |   Area    (ha)=   2.20
|ID= 1 DT= 5.0 min |   Total Imp(%)=  75.00   Dir. Conn.(%)=  75.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
```

```
     Surface Area     (ha)=       1.65         0.55
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       2.00         2.00
     Length            (m)=     121.11        40.00
     Mannings n          =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=      43.98        18.61
                over (min)       5.00        20.00
     Storage Coeff.  (min)=       3.23 (ii)   17.06 (ii)
     Unit Hyd. Tpeak (min)=       5.00        20.00
     Unit Hyd. peak  (cms)=       0.27         0.06
                                                          *TOTALS*
     PEAK FLOW       (cms)=       0.20         0.02         0.219 (iii)
     TIME TO PEAK    (hrs)=       2.50         2.67          2.50
     RUNOFF VOLUME    (mm)=      46.80        16.37         39.19
     TOTAL RAINFALL   (mm)=      47.80        47.80         47.80
     RUNOFF COEFFICIENT   =       0.98         0.34          0.82

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

---------------------------------------------------------------------------------
--------------------
| CALIB              |
| STANDHYD  (0160)  |   Area    (ha)=   0.54
|ID= 1 DT= 5.0 min  |   Total Imp(%)=  75.00   Dir. Conn.(%)=  75.00
--------------------
                                IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       0.41         0.14
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       2.00         2.00
     Length            (m)=      60.00        40.00
     Mannings n          =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=      43.98        18.61
                over (min)       5.00        20.00
     Storage Coeff.  (min)=       2.12 (ii)   15.95 (ii)
     Unit Hyd. Tpeak (min)=       5.00        20.00
     Unit Hyd. peak  (cms)=       0.31         0.07
                                                          *TOTALS*
     PEAK FLOW       (cms)=       0.05         0.00         0.054 (iii)
     TIME TO PEAK    (hrs)=       2.50         2.67          2.50
     RUNOFF VOLUME    (mm)=      46.80        16.37         39.18
     TOTAL RAINFALL   (mm)=      47.80        47.80         47.80
     RUNOFF COEFFICIENT   =       0.98         0.34          0.82

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

---------------------------------------------------------------------------------
--------------------
| DUHYD     (0010) |
| Inlet Cap.=0.054 |
| #of Inlets=    1 |
| Total(cms)=  0.1 |       AREA     QPEAK     TPEAK    R.V.
--------------------       (ha)     (cms)     (hrs)    (mm)
     TOTAL HYD.(ID= 1):   0.54      0.05      2.50   39.18
     ==================================================
     MAJOR SYS.(ID= 2):   0.00      0.00      0.00    0.00
     MINOR SYS.(ID= 3):   0.54      0.05      2.50   39.18

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

---------------------------------------------------------------------------------

--------------------
| ADD HYD   (0005) |
|   1 +  2 =  3    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
*** W A R N I N G :  HYDROGRAPH 0010 <ID= 1> IS DRY.
*** W A R N I N G :  HYDROGRAPH 0005 = HYDROGRAPH 0110
*** W A R N I N G :  HYDROGRAPH 0005 = HYDROGRAPH 0110
          ID1= 1 (0010):      0.00   0.000     0.00     0.00
        + ID2= 2 (0110):      2.89   0.221     2.50    31.58
```

```
          ==================================================
          ID = 3 (0005):     2.89   0.221     2.50    31.58

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------

--------------------
| ADD HYD   (0005) |
|   3 +  2 =  1    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
          ID1= 3 (0005):     2.89   0.221     2.50    31.58
        + ID2= 2 (0120):     1.49   0.165     2.50    43.14
          ==================================================
          ID = 1 (0005):     4.38   0.386     2.50    35.51

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------

--------------------
| ADD HYD   (0005) |
|   1 +  2 =  3    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
          ID1= 1 (0005):     4.38   0.386     2.50    35.51
        + ID2= 2 (0130):     0.53   0.033     2.50    27.00
          ==================================================
          ID = 3 (0005):     4.91   0.418     2.50    34.60

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------

--------------------
| ADD HYD   (0005) |
|   3 +  2 =  1    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
          ID1= 3 (0005):     4.91   0.418     2.50    34.60
        + ID2= 2 (0140):     2.20   0.219     2.50    39.19
          ==================================================
          ID = 1 (0005):     7.11   0.637     2.50    36.02

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------

--------------------
| ADD HYD   (0005) |
|   1 +  2 =  3    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
          ID1= 1 (0005):     7.11   0.637     2.50    36.02
        + ID2= 2 (0150):     3.18   0.080     3.00    16.37
          ==================================================
          ID = 3 (0005):    10.29   0.684     2.50    29.94

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR (0006) |
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |      OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------       (cms)     (ha.m.)   |   (cms)     (ha.m.)
                           0.0000     0.0000   |   0.0320      0.1782
                           0.0050     0.0211   |   0.1250      0.2093
                           0.0080     0.0440   |   0.4240      0.2417
                           0.0110     0.0683   |   0.8410      0.2757
                           0.0130     0.0938   |   1.3500      0.3113
                           0.0140     0.1205   |   1.9300      0.3486
                           0.0160     0.1486   |   2.5900      0.3876

                                 AREA     QPEAK     TPEAK       R.V.
                                 (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 2 (0005)     10.290      0.684      2.50      29.94
     OUTFLOW: ID= 1 (0006)     10.290      0.174      3.50      29.84

                     PEAK   FLOW   REDUCTION [Qout/Qin](%)= 25.42
                     TIME SHIFT OF PEAK FLOW         (min)= 60.00
                     MAXIMUM  STORAGE   USED       (ha.m.)=  0.2147

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD  (0011) |   Area    (ha)=   0.00
```

```
|ID= 1 DT= 5.0 min |   Total Imp(%)=  50.00   Dir. Conn.(%)=  35.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       0.00          0.00
     Dep. Storage     (mm)=       1.00          1.50
     Average Slope     (%)=       1.00          2.00
     Length            (m)=       0.00         40.00
     Mannings n           =      0.013         0.250

     Max.Eff.Inten.(mm/hr)=      43.98         41.85
              over (min)          5.00         10.00
     Storage Coeff.  (min)=       0.00 (ii)    10.00 (ii)
     Unit Hyd. Tpeak (min)=       5.00         10.00
     Unit Hyd. peak  (cms)=       0.34          0.16
                                                             *TOTALS*
     PEAK FLOW       (cms)=       0.00          0.00           0.000 (iii)
     TIME TO PEAK    (hrs)=       0.00          0.00            0.00
     RUNOFF VOLUME    (mm)=    NaN           NaN            NaN
     TOTAL RAINFALL   (mm)=      47.80         47.80          47.80
     RUNOFF COEFFICIENT   =    NaN           NaN            NaN

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 50.00          K  (1/hr)=  2.00
            Fc   (mm/hr)=  7.50     Cum.Inf.   (mm)=  0.00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------

--------------------
| ADD HYD   (0012) |
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
*** W A R N I N G :  HYDROGRAPH 0011 &lt;ID= 2&gt; IS DRY.
*** W A R N I N G :  HYDROGRAPH 0003 = HYDROGRAPH 0001
*** W A R N I N G :  HYDROGRAPH 0003 = HYDROGRAPH 0001
          ID1= 1 (0010):     0.54   0.054     2.50    39.18
        + ID2= 2 (0011):     0.00   0.000     0.00   NaN
          ================================================
          ID = 3 (0012):     0.54   0.054     2.50    39.18

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

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  ****************************
  ** SIMULATION NUMBER:   3 **
  ****************************


--------------------
|    READ STORM    |    Filename: C:\Users\jiantomasi\AppD
|                  |              ata\Local\Temp\
|                  |              0ca6545a-89e5-4cbd-9772-39d4c2518c8e\a3bfaa1b
| Ptotal= 55.70 mm |    Comments: Toronto Bloor: 6-hr, 10-yr storm
--------------------
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                 0.25    1.11 |  1.75   18.94 |  3.25    7.80 |  4.75    1.11
                 0.50    1.11 |  2.00   18.94 |  3.50    7.80 |  5.00    1.11
                 0.75    1.11 |  2.25   51.24 |  3.75    4.46 |  5.25    1.11
                 1.00    1.11 |  2.50   51.24 |  4.00    4.46 |  5.50    1.11
                 1.25    6.68 |  2.75   14.48 |  4.25    2.23 |  5.75    1.11
                 1.50    6.68 |  3.00   14.48 |  4.50    2.23 |  6.00    1.11

--------------------------------------------------------------------------------

--------------------
| CALIB            |
| NASHYD    (0150) |   Area    (ha)=   3.18   Curve Number   (CN)= 75.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   1.50   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.56

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                                  ---- TRANSFORMED HYETOGRAPH ----
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.083    1.11 | 1.583   18.94 | 3.083    7.80 |  4.58    1.11
                0.167    1.11 | 1.667   18.94 | 3.167    7.80 |  4.67    1.11
                0.250    1.11 | 1.750   18.94 | 3.250    7.80 |  4.75    1.11
```

```
            0.333    1.11 | 1.833   18.94 | 3.333    7.80 |  4.83    1.11
            0.417    1.11 | 1.917   18.94 | 3.417    7.80 |  4.92    1.11
            0.500    1.11 | 2.000   18.94 | 3.500    7.80 |  5.00    1.11
            0.583    1.11 | 2.083   51.24 | 3.583    4.46 |  5.08    1.11
            0.667    1.11 | 2.167   51.24 | 3.667    4.46 |  5.17    1.11
            0.750    1.11 | 2.250   51.24 | 3.750    4.46 |  5.25    1.11
            0.833    1.11 | 2.333   51.24 | 3.833    4.46 |  5.33    1.11
            0.917    1.11 | 2.417   51.24 | 3.917    4.46 |  5.42    1.11
            1.000    1.11 | 2.500   51.24 | 4.000    4.46 |  5.50    1.11
            1.083    6.68 | 2.583   14.48 | 4.083    2.23 |  5.58    1.11
            1.167    6.68 | 2.667   14.48 | 4.167    2.23 |  5.67    1.11
            1.250    6.68 | 2.750   14.48 | 4.250    2.23 |  5.75    1.11
            1.333    6.68 | 2.833   14.48 | 4.333    2.23 |  5.83    1.11
            1.417    6.68 | 2.917   14.48 | 4.417    2.23 |  5.92    1.11
            1.500    6.68 | 3.000   14.48 | 4.500    2.23 |  6.00    1.11

     Unit Hyd Qpeak  (cms)=   0.217

     PEAK FLOW       (cms)=   0.103 (i)
     TIME TO PEAK    (hrs)=   3.000
     RUNOFF VOLUME    (mm)=  21.152
     TOTAL RAINFALL   (mm)=  55.698
     RUNOFF COEFFICIENT   =   0.380

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB              |
| STANDHYD  (0110)  |   Area    (ha)=   2.89
|ID= 1 DT= 5.0 min |   Total Imp(%)=  50.00   Dir. Conn.(%)=  50.00
--------------------
                                  IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       1.45          1.45
     Dep. Storage     (mm)=       1.00          1.50
     Average Slope     (%)=       2.00          2.00
     Length            (m)=     138.80         40.00
     Mannings n           =      0.013         0.250

     Max.Eff.Inten.(mm/hr)=      51.24         24.00
                over (min)        5.00         20.00
     Storage Coeff.  (min)=       3.30 (ii)    15.79 (ii)
     Unit Hyd. Tpeak (min)=       5.00         20.00
     Unit Hyd. peak  (cms)=       0.27          0.07
                                                            *TOTALS*
     PEAK FLOW       (cms)=       0.21          0.07          0.266 (iii)
     TIME TO PEAK    (hrs)=       2.50          2.67           2.50
     RUNOFF VOLUME    (mm)=      54.70         21.15          37.92
     TOTAL RAINFALL   (mm)=      55.70         55.70          55.70
     RUNOFF COEFFICIENT   =       0.98          0.38           0.68

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB              |
| STANDHYD  (0120)  |   Area    (ha)=   1.49
|ID= 1 DT= 5.0 min |   Total Imp(%)=  88.00   Dir. Conn.(%)=  88.00
--------------------
                                  IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       1.31          0.18
     Dep. Storage     (mm)=       1.00          1.50
     Average Slope     (%)=       2.00          1.00
     Length            (m)=      99.67         40.00
     Mannings n           =      0.013         0.250

     Max.Eff.Inten.(mm/hr)=      51.24         22.90
                over (min)        5.00         20.00
     Storage Coeff.  (min)=       2.71 (ii)    18.37 (ii)
     Unit Hyd. Tpeak (min)=       5.00         20.00
     Unit Hyd. peak  (cms)=       0.29          0.06
                                                            *TOTALS*
     PEAK FLOW       (cms)=       0.19          0.01          0.194 (iii)
     TIME TO PEAK    (hrs)=       2.50          2.67           2.50
     RUNOFF VOLUME    (mm)=      54.70         21.15          50.67
     TOTAL RAINFALL   (mm)=      55.70         55.70          55.70
     RUNOFF COEFFICIENT   =       0.98          0.38           0.91
```

```
***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB              |
| STANDHYD  (0130) |   Area    (ha)=   0.53
|ID= 1 DT= 5.0 min |   Total Imp(%)=  35.00   Dir. Conn.(%)=  35.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       0.19          0.34
     Dep. Storage     (mm)=       1.00          1.50
     Average Slope     (%)=       1.00          1.00
     Length            (m)=      59.44         40.00
     Mannings n           =      0.013         0.250

     Max.Eff.Inten.(mm/hr)=      51.24         22.90
                over (min)        5.00         20.00
     Storage Coeff.  (min)=       2.44 (ii)    18.11 (ii)
     Unit Hyd. Tpeak (min)=       5.00         20.00
     Unit Hyd. peak  (cms)=       0.30          0.06
                                                              *TOTALS*
     PEAK FLOW       (cms)=       0.03          0.02            0.040 (iii)
     TIME TO PEAK    (hrs)=       2.50          2.67             2.50
     RUNOFF VOLUME    (mm)=      54.70         21.15            32.87
     TOTAL RAINFALL   (mm)=      55.70         55.70            55.70
     RUNOFF COEFFICIENT   =       0.98          0.38             0.59

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB              |
| STANDHYD  (0140) |   Area    (ha)=   2.20
|ID= 1 DT= 5.0 min |   Total Imp(%)=  75.00   Dir. Conn.(%)=  75.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       1.65          0.55
     Dep. Storage     (mm)=       1.00          1.50
     Average Slope     (%)=       2.00          2.00
     Length            (m)=     121.11         40.00
     Mannings n           =      0.013         0.250

     Max.Eff.Inten.(mm/hr)=      51.24         24.00
                over (min)        5.00         20.00
     Storage Coeff.  (min)=       3.04 (ii)    15.53 (ii)
     Unit Hyd. Tpeak (min)=       5.00         20.00
     Unit Hyd. peak  (cms)=       0.27          0.07
                                                              *TOTALS*
     PEAK FLOW       (cms)=       0.23          0.03            0.258 (iii)
     TIME TO PEAK    (hrs)=       2.50          2.67             2.50
     RUNOFF VOLUME    (mm)=      54.70         21.15            46.31
     TOTAL RAINFALL   (mm)=      55.70         55.70            55.70
     RUNOFF COEFFICIENT   =       0.98          0.38             0.83

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB              |
| STANDHYD  (0160) |   Area    (ha)=   0.54
|ID= 1 DT= 5.0 min |   Total Imp(%)=  75.00   Dir. Conn.(%)=  75.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       0.41          0.14
     Dep. Storage     (mm)=       1.00          1.50
     Average Slope     (%)=       2.00          2.00
```

```
     Length            (m)=      60.00        40.00
     Mannings n           =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=      51.24        24.00
               over (min)         5.00        15.00
     Storage Coeff.  (min)=       2.00 (ii)   14.49 (ii)
     Unit Hyd. Tpeak (min)=       5.00        15.00
     Unit Hyd. peak  (cms)=       0.31         0.08
                                                             *TOTALS*
     PEAK FLOW       (cms)=       0.06         0.01            0.064 (iii)
     TIME TO PEAK    (hrs)=       2.50         2.58             2.50
     RUNOFF VOLUME    (mm)=      54.70        21.15            46.30
     TOTAL RAINFALL   (mm)=      55.70        55.70            55.70
     RUNOFF COEFFICIENT   =       0.98         0.38             0.83

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| DUHYD     (0010) |
| Inlet Cap.=0.054 |
| #of Inlets=    1 |
| Total(cms)=  0.1 |      AREA     QPEAK     TPEAK    R.V.
--------------------      (ha)     (cms)     (hrs)    (mm)
     TOTAL HYD.(ID= 1):   0.54      0.06      2.50   46.30
     ====================================================
     MAJOR SYS.(ID= 2):   0.03      0.01      2.50   46.30
     MINOR SYS.(ID= 3):   0.51      0.05      2.08   46.30

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

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--------------------
| ADD HYD   (0005) |
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
          ID1= 1 (0010):     0.03   0.010     2.50    46.30
        + ID2= 2 (0110):     2.89   0.266     2.50    37.92
          ==================================================
          ID = 3 (0005):     2.92   0.277     2.50    38.00

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------

--------------------
| ADD HYD   (0005) |
|   3 +  2 =  1    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
          ID1= 3 (0005):     2.92   0.277     2.50    38.00
        + ID2= 2 (0120):     1.49   0.194     2.50    50.67
          ==================================================
          ID = 1 (0005):     4.41   0.470     2.50    42.28

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

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--------------------
| ADD HYD   (0005) |
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
          ID1= 1 (0005):     4.41   0.470     2.50    42.28
        + ID2= 2 (0130):     0.53   0.040     2.50    32.87
          ==================================================
          ID = 3 (0005):     4.94   0.510     2.50    41.27

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------

--------------------
| ADD HYD   (0005) |
|   3 +  2 =  1    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
          ID1= 3 (0005):     4.94   0.510     2.50    41.27
        + ID2= 2 (0140):     2.20   0.258     2.50    46.31
```

```
          ==================================================
          ID = 1 (0005):     7.14   0.769     2.50    42.82

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------

--------------------
| ADD HYD   (0005) |
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
          ID1= 1 (0005):     7.14   0.769     2.50    42.82
        + ID2= 2 (0150):     3.18   0.103     3.00    21.15
          ==================================================
          ID = 3 (0005):    10.32   0.830     2.50    36.14

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------
--------------------
| RESERVOIR (0006) |
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |   0.0320      0.1782
                          0.0050     0.0211   |   0.1250      0.2093
                          0.0080     0.0440   |   0.4240      0.2417
                          0.0110     0.0683   |   0.8410      0.2757
                          0.0130     0.0938   |   1.3500      0.3113
                          0.0140     0.1205   |   1.9300      0.3486
                          0.0160     0.1486   |   2.5900      0.3876

                               AREA     QPEAK     TPEAK       R.V.
                               (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 2 (0005)     10.317      0.830      2.50      36.14
     OUTFLOW: ID= 1 (0006)     10.317      0.290      3.08      36.04

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)= 34.98
                   TIME SHIFT OF PEAK FLOW         (min)= 35.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=  0.2272

-------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD  (0011) |   Area    (ha)=   0.00
|ID= 1 DT= 5.0 min |   Total Imp(%)=  50.00   Dir. Conn.(%)=  35.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       0.00         0.00
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=       0.00        40.00
     Mannings n          =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=      51.24        52.76
                over (min)        5.00        10.00
     Storage Coeff.  (min)=       0.00 (ii)    9.11 (ii)
     Unit Hyd. Tpeak (min)=       5.00        10.00
     Unit Hyd. peak  (cms)=       0.34         0.16
                                                            *TOTALS*
     PEAK FLOW       (cms)=       0.00         0.00           0.000 (iii)
     TIME TO PEAK    (hrs)=       0.00         0.00            0.00
     RUNOFF VOLUME    (mm)=    NaN          NaN            NaN
     TOTAL RAINFALL   (mm)=      55.70        55.70           55.70
     RUNOFF COEFFICIENT   =    NaN          NaN            NaN

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 50.00          K  (1/hr)=  2.00
            Fc   (mm/hr)=  7.50     Cum.Inf.   (mm)=  0.00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------

--------------------
| ADD HYD   (0012) |
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
*** W A R N I N G :  HYDROGRAPH 0011 <ID= 2> IS DRY.
*** W A R N I N G :  HYDROGRAPH 0003 = HYDROGRAPH 0001
*** W A R N I N G :  HYDROGRAPH 0003 = HYDROGRAPH 0001
```

```
        ID1= 1 (0010):     0.51   0.054     2.08    46.30
      + ID2= 2 (0011):     0.00   0.000     0.00   NaN
        =================================================
        ID = 3 (0012):     0.51   0.054     2.08    46.30

    NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

-------------------------------------------------------------------------------
  ****************************
  ** SIMULATION NUMBER:   4 **
  ****************************


--------------------
|    READ STORM    |    Filename: C:\Users\jiantomasi\AppD
|                  |              ata\Local\Temp\
|                  |              0ca6545a-89e5-4cbd-9772-39d4c2518c8e\551f7560
| Ptotal= 65.60 mm |    Comments: Toronto Bloor: 6-hr, 25-yr storm
--------------------
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                 0.25    1.31 |  1.75   22.30 |  3.25    9.18 |  4.75    1.31
                 0.50    1.31 |  2.00   22.30 |  3.50    9.18 |  5.00    1.31
                 0.75    1.31 |  2.25   60.35 |  3.75    5.25 |  5.25    1.31
                 1.00    1.31 |  2.50   60.35 |  4.00    5.25 |  5.50    1.31
                 1.25    7.87 |  2.75   17.06 |  4.25    2.62 |  5.75    1.31
                 1.50    7.87 |  3.00   17.06 |  4.50    2.62 |  6.00    1.31

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--------------------
| CALIB            |
| NASHYD    (0150) |   Area    (ha)=   3.18   Curve Number   (CN)= 75.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   1.50   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.56

        NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                              ---- TRANSFORMED HYETOGRAPH ----
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.083    1.31 | 1.583   22.30 | 3.083    9.18 |  4.58    1.31
                0.167    1.31 | 1.667   22.30 | 3.167    9.18 |  4.67    1.31
                0.250    1.31 | 1.750   22.30 | 3.250    9.18 |  4.75    1.31
                0.333    1.31 | 1.833   22.30 | 3.333    9.18 |  4.83    1.31
                0.417    1.31 | 1.917   22.30 | 3.417    9.18 |  4.92    1.31
                0.500    1.31 | 2.000   22.30 | 3.500    9.18 |  5.00    1.31
                0.583    1.31 | 2.083   60.35 | 3.583    5.25 |  5.08    1.31
                0.667    1.31 | 2.167   60.35 | 3.667    5.25 |  5.17    1.31
                0.750    1.31 | 2.250   60.35 | 3.750    5.25 |  5.25    1.31
                0.833    1.31 | 2.333   60.35 | 3.833    5.25 |  5.33    1.31
                0.917    1.31 | 2.417   60.35 | 3.917    5.25 |  5.42    1.31
                1.000    1.31 | 2.500   60.35 | 4.000    5.25 |  5.50    1.31
                1.083    7.87 | 2.583   17.06 | 4.083    2.62 |  5.58    1.31
                1.167    7.87 | 2.667   17.06 | 4.167    2.62 |  5.67    1.31
                1.250    7.87 | 2.750   17.06 | 4.250    2.62 |  5.75    1.31
                1.333    7.87 | 2.833   17.06 | 4.333    2.62 |  5.83    1.31
                1.417    7.87 | 2.917   17.06 | 4.417    2.62 |  5.92    1.31
                1.500    7.87 | 3.000   17.06 | 4.500    2.62 |  6.00    1.31

    Unit Hyd Qpeak  (cms)=   0.217

    PEAK FLOW       (cms)=   0.136 (i)
    TIME TO PEAK    (hrs)=   3.000
    RUNOFF VOLUME    (mm)=  27.617
    TOTAL RAINFALL   (mm)=  65.599
    RUNOFF COEFFICIENT   =   0.421

    (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD  (0110) |   Area    (ha)=   2.89
|ID= 1 DT= 5.0 min |   Total Imp(%)=  50.00   Dir. Conn.(%)=  50.00
--------------------
                                IMPERVIOUS    PERVIOUS (i)
    Surface Area     (ha)=        1.45          1.45
    Dep. Storage     (mm)=        1.00          1.50
    Average Slope     (%)=        2.00          2.00
    Length            (m)=      138.80         40.00
    Mannings n           =       0.013         0.250
```

```
     Max.Eff.Inten.(mm/hr)=      60.35        31.27
              over (min)        5.00        15.00
     Storage Coeff.  (min)=       3.09 (ii)   14.33 (ii)
     Unit Hyd. Tpeak (min)=       5.00        15.00
     Unit Hyd. peak  (cms)=       0.27         0.08
                                                          *TOTALS*
     PEAK FLOW       (cms)=       0.24         0.10          0.334 (iii)
     TIME TO PEAK    (hrs)=       2.50         2.58           2.50
     RUNOFF VOLUME    (mm)=      64.60        27.62          46.11
     TOTAL RAINFALL   (mm)=      65.60        65.60          65.60
     RUNOFF COEFFICIENT   =       0.98         0.42           0.70

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB              |
| STANDHYD  (0120) |   Area    (ha)=   1.49
|ID= 1 DT= 5.0 min |   Total Imp(%)=  88.00   Dir. Conn.(%)=  88.00
--------------------
                                IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       1.31         0.18
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       2.00         1.00
     Length            (m)=      99.67        40.00
     Mannings n           =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=      60.35        32.49
              over (min)        5.00        10.00
     Storage Coeff.  (min)=       2.53 (ii)    7.33 (ii)
     Unit Hyd. Tpeak (min)=       5.00        10.00
     Unit Hyd. peak  (cms)=       0.29         0.13
                                                          *TOTALS*
     PEAK FLOW       (cms)=       0.22         0.01          0.234 (iii)
     TIME TO PEAK    (hrs)=       2.50         2.50           2.50
     RUNOFF VOLUME    (mm)=      64.60        27.62          60.16
     TOTAL RAINFALL   (mm)=      65.60        65.60          65.60
     RUNOFF COEFFICIENT   =       0.98         0.42           0.92

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB              |
| STANDHYD  (0130) |   Area    (ha)=   0.53
|ID= 1 DT= 5.0 min |   Total Imp(%)=  35.00   Dir. Conn.(%)=  35.00
--------------------
                                IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       0.19         0.34
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         1.00
     Length            (m)=      59.44        40.00
     Mannings n           =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=      60.35        31.27
              over (min)        5.00        20.00
     Storage Coeff.  (min)=       2.29 (ii)   16.12 (ii)
     Unit Hyd. Tpeak (min)=       5.00        20.00
     Unit Hyd. peak  (cms)=       0.30         0.06
                                                          *TOTALS*
     PEAK FLOW       (cms)=       0.03         0.02          0.050 (iii)
     TIME TO PEAK    (hrs)=       2.50         2.67           2.50
     RUNOFF VOLUME    (mm)=      64.60        27.62          40.54
     TOTAL RAINFALL   (mm)=      65.60        65.60          65.60
     RUNOFF COEFFICIENT   =       0.98         0.42           0.62

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
```

```
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB              |
| STANDHYD  (0140) |   Area    (ha)=   2.20
|ID= 1 DT= 5.0 min |   Total Imp(%)=  75.00   Dir. Conn.(%)=  75.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       1.65         0.55
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       2.00         2.00
     Length            (m)=     121.11        40.00
     Mannings n           =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=      60.35        31.27
                over (min)        5.00        15.00
     Storage Coeff.  (min)=       2.85 (ii)   14.09 (ii)
     Unit Hyd. Tpeak (min)=       5.00        15.00
     Unit Hyd. peak  (cms)=       0.28         0.08
                                                            *TOTALS*
     PEAK FLOW       (cms)=       0.28         0.04           0.312 (iii)
     TIME TO PEAK    (hrs)=       2.50         2.58            2.50
     RUNOFF VOLUME    (mm)=      64.60        27.62           55.35
     TOTAL RAINFALL   (mm)=      65.60        65.60           65.60
     RUNOFF COEFFICIENT   =       0.98         0.42            0.84

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB              |
| STANDHYD  (0160) |   Area    (ha)=   0.54
|ID= 1 DT= 5.0 min |   Total Imp(%)=  75.00   Dir. Conn.(%)=  75.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       0.41         0.14
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       2.00         2.00
     Length            (m)=      60.00        40.00
     Mannings n           =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=      60.35        31.27
                over (min)        5.00        15.00
     Storage Coeff.  (min)=       1.87 (ii)   13.11 (ii)
     Unit Hyd. Tpeak (min)=       5.00        15.00
     Unit Hyd. peak  (cms)=       0.32         0.08
                                                            *TOTALS*
     PEAK FLOW       (cms)=       0.07         0.01           0.077 (iii)
     TIME TO PEAK    (hrs)=       2.50         2.58            2.50
     RUNOFF VOLUME    (mm)=      64.60        27.62           55.34
     TOTAL RAINFALL   (mm)=      65.60        65.60           65.60
     RUNOFF COEFFICIENT   =       0.98         0.42            0.84

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| DUHYD     (0010) |
| Inlet Cap.=0.054 |
| #of Inlets=    1 |
| Total(cms)=  0.1 |      AREA     QPEAK     TPEAK    R.V.
--------------------      (ha)     (cms)     (hrs)    (mm)
     TOTAL HYD.(ID= 1):   0.54      0.08      2.50   55.34
     ====================================================
     MAJOR SYS.(ID= 2):   0.06      0.02      2.50   55.34
     MINOR SYS.(ID= 3):   0.48      0.05      2.08   55.34

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
```

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--------------------
| ADD HYD   (0005) |
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
          ID1= 1 (0010):     0.06   0.023     2.50    55.34
        + ID2= 2 (0110):     2.89   0.334     2.50    46.11
          ==================================================
          ID = 3 (0005):     2.95   0.357     2.50    46.30

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------

--------------------
| ADD HYD   (0005) |
|   3 +  2 =  1    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
          ID1= 3 (0005):     2.95   0.357     2.50    46.30
        + ID2= 2 (0120):     1.49   0.234     2.50    60.16
          ==================================================
          ID = 1 (0005):     4.44   0.591     2.50    50.95

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------

--------------------
| ADD HYD   (0005) |
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
          ID1= 1 (0005):     4.44   0.591     2.50    50.95
        + ID2= 2 (0130):     0.53   0.050     2.50    40.54
          ==================================================
          ID = 3 (0005):     4.97   0.641     2.50    49.84

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

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--------------------
| ADD HYD   (0005) |
|   3 +  2 =  1    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
          ID1= 3 (0005):     4.97   0.641     2.50    49.84
        + ID2= 2 (0140):     2.20   0.312     2.50    55.35
          ==================================================
          ID = 1 (0005):     7.17   0.953     2.50    51.53

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------

--------------------
| ADD HYD   (0005) |
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
          ID1= 1 (0005):     7.17   0.953     2.50    51.53
        + ID2= 2 (0150):     3.18   0.136     3.00    27.62
          ==================================================
          ID = 3 (0005):    10.35   1.036     2.50    44.18

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR (0006) |
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |   0.0320      0.1782
                          0.0050     0.0211   |   0.1250      0.2093
                          0.0080     0.0440   |   0.4240      0.2417
                          0.0110     0.0683   |   0.8410      0.2757
                          0.0130     0.0938   |   1.3500      0.3113
                          0.0140     0.1205   |   1.9300      0.3486
                          0.0160     0.1486   |   2.5900      0.3876

                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 2 (0005)     10.351      1.036      2.50      44.18
     OUTFLOW: ID= 1 (0006)     10.351      0.437      3.00      44.08

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)= 42.19
                  TIME SHIFT OF PEAK FLOW         (min)= 30.00
```

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                  MAXIMUM   STORAGE   USED       (ha.m.)=  0.2429

--------------------------------------------------------------------------------
--------------------
| CALIB             |
| STANDHYD  (0011)  |   Area    (ha)=   0.00
|ID= 1 DT= 5.0 min  |   Total Imp(%)=  50.00   Dir. Conn.(%)=  35.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       0.00         0.00
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=       0.00        40.00
     Mannings n           =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=      60.35        65.66
                over (min)        5.00        10.00
     Storage Coeff.  (min)=       0.00 (ii)    8.35 (ii)
     Unit Hyd. Tpeak (min)=       5.00        10.00
     Unit Hyd. peak  (cms)=       0.34         0.17
                                                             *TOTALS*
     PEAK FLOW       (cms)=       0.00         0.00            0.000 (iii)
     TIME TO PEAK    (hrs)=       0.00         0.00             0.00
     RUNOFF VOLUME    (mm)=    NaN          NaN              NaN
     TOTAL RAINFALL   (mm)=      65.60        65.60            65.60
     RUNOFF COEFFICIENT   =    NaN          NaN              NaN

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 50.00           K  (1/hr)=  2.00
            Fc   (mm/hr)=  7.50     Cum.Inf.   (mm)=  0.00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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--------------------
| ADD HYD   (0012) |
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
*** W A R N I N G :  HYDROGRAPH 0011 <ID= 2> IS DRY.
*** W A R N I N G :  HYDROGRAPH 0003 = HYDROGRAPH 0001
*** W A R N I N G :  HYDROGRAPH 0003 = HYDROGRAPH 0001
          ID1= 1 (0010):     0.48   0.054     2.08    55.34
        + ID2= 2 (0011):     0.00   0.000     0.00   NaN
          ==================================================
          ID = 3 (0012):     0.48   0.054     2.08    55.34

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
  ****************************
  ** SIMULATION NUMBER:   5 **
  ****************************


--------------------
|    READ STORM     |    Filename: C:\Users\jiantomasi\AppD
|                   |              ata\Local\Temp\
|                   |              0ca6545a-89e5-4cbd-9772-39d4c2518c8e\b753d7f0
| Ptotal= 73.00 mm  |    Comments: Toronto Bloor: 6-hr, 50-yr storm
--------------------
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                 0.25    1.46 |  1.75   24.82 |  3.25   10.22 |  4.75    1.46
                 0.50    1.46 |  2.00   24.82 |  3.50   10.22 |  5.00    1.46
                 0.75    1.46 |  2.25   67.16 |  3.75    5.84 |  5.25    1.46
                 1.00    1.46 |  2.50   67.16 |  4.00    5.84 |  5.50    1.46
                 1.25    8.76 |  2.75   18.98 |  4.25    2.92 |  5.75    1.46
                 1.50    8.76 |  3.00   18.98 |  4.50    2.92 |  6.00    1.46

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--------------------
| CALIB             |
| NASHYD    (0150)  |   Area    (ha)=   3.18   Curve Number   (CN)= 75.0
|ID= 1 DT= 5.0 min  |   Ia      (mm)=   1.50   # of Linear Res.(N)= 3.00
--------------------    U.H. Tp(hrs)=   0.56

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.
```

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.083	1.46	1.583	24.82	3.083	10.22	4.58	1.46
0.167	1.46	1.667	24.82	3.167	10.22	4.67	1.46
0.250	1.46	1.750	24.82	3.250	10.22	4.75	1.46
0.333	1.46	1.833	24.82	3.333	10.22	4.83	1.46
0.417	1.46	1.917	24.82	3.417	10.22	4.92	1.46
0.500	1.46	2.000	24.82	3.500	10.22	5.00	1.46
0.583	1.46	2.083	67.16	3.583	5.84	5.08	1.46
0.667	1.46	2.167	67.16	3.667	5.84	5.17	1.46
0.750	1.46	2.250	67.16	3.750	5.84	5.25	1.46
0.833	1.46	2.333	67.16	3.833	5.84	5.33	1.46
0.917	1.46	2.417	67.16	3.917	5.84	5.42	1.46
1.000	1.46	2.500	67.16	4.000	5.84	5.50	1.46
1.083	8.76	2.583	18.98	4.083	2.92	5.58	1.46
1.167	8.76	2.667	18.98	4.167	2.92	5.67	1.46
1.250	8.76	2.750	18.98	4.250	2.92	5.75	1.46
1.333	8.76	2.833	18.98	4.333	2.92	5.83	1.46
1.417	8.76	2.917	18.98	4.417	2.92	5.92	1.46
1.500	8.76	3.000	18.98	4.500	2.92	6.00	1.46

```
     Unit Hyd Qpeak  (cms)=   0.217

     PEAK FLOW       (cms)=   0.161 (i)
     TIME TO PEAK    (hrs)=   3.000
     RUNOFF VOLUME    (mm)=  32.734
     TOTAL RAINFALL   (mm)=  73.000
     RUNOFF COEFFICIENT   =   0.448

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB             |
| STANDHYD  (0110) |   Area    (ha)=   2.89
|ID= 1 DT= 5.0 min |   Total Imp(%)=  50.00   Dir. Conn.(%)=  50.00
--------------------
                                IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        1.45          1.45
     Dep. Storage     (mm)=        1.00          1.50
     Average Slope     (%)=        2.00          2.00
     Length            (m)=      138.80         40.00
     Mannings n           =       0.013         0.250

     Max.Eff.Inten.(mm/hr)=       67.16         36.99
                over (min)         5.00         15.00
     Storage Coeff.  (min)=        2.96 (ii)    13.47 (ii)
     Unit Hyd. Tpeak (min)=        5.00         15.00
     Unit Hyd. peak  (cms)=        0.28          0.08
                                                              *TOTALS*
     PEAK FLOW       (cms)=        0.27          0.12           0.382 (iii)
     TIME TO PEAK    (hrs)=        2.50          2.58            2.50
     RUNOFF VOLUME    (mm)=       72.00         32.74           52.37
     TOTAL RAINFALL   (mm)=       73.00         73.00           73.00
     RUNOFF COEFFICIENT   =        0.99          0.45            0.72

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB             |
| STANDHYD  (0120) |   Area    (ha)=   1.49
|ID= 1 DT= 5.0 min |   Total Imp(%)=  88.00   Dir. Conn.(%)=  88.00
--------------------
                                IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        1.31          0.18
     Dep. Storage     (mm)=        1.00          1.50
     Average Slope     (%)=        2.00          1.00
     Length            (m)=       99.67         40.00
     Mannings n           =       0.013         0.250

     Max.Eff.Inten.(mm/hr)=       67.16         38.35
                over (min)         5.00         10.00
     Storage Coeff.  (min)=        2.43 (ii)     7.02 (ii)
     Unit Hyd. Tpeak (min)=        5.00         10.00
     Unit Hyd. peak  (cms)=        0.30          0.14
                                                              *TOTALS*
```

```
     PEAK FLOW       (cms)=       0.24         0.02          0.262 (iii)
     TIME TO PEAK    (hrs)=       2.50         2.50           2.50
     RUNOFF VOLUME    (mm)=      72.00        32.74          67.29
     TOTAL RAINFALL   (mm)=      73.00        73.00          73.00
     RUNOFF COEFFICIENT   =       0.99         0.45           0.92

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB             |
| STANDHYD  (0130) |   Area    (ha)=   0.53
|ID= 1 DT= 5.0 min |   Total Imp(%)=  35.00   Dir. Conn.(%)=  35.00
--------------------
                                IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       0.19         0.34
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         1.00
     Length            (m)=      59.44        40.00
     Mannings n           =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=      67.16        36.99
                over (min)        5.00        20.00
     Storage Coeff.  (min)=       2.19 (ii)   15.13 (ii)
     Unit Hyd. Tpeak (min)=       5.00        20.00
     Unit Hyd. peak  (cms)=       0.31         0.07
                                                          *TOTALS*
     PEAK FLOW       (cms)=       0.03         0.03          0.058 (iii)
     TIME TO PEAK    (hrs)=       2.50         2.67           2.50
     RUNOFF VOLUME    (mm)=      72.00        32.74          46.46
     TOTAL RAINFALL   (mm)=      73.00        73.00          73.00
     RUNOFF COEFFICIENT   =       0.99         0.45           0.64

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB             |
| STANDHYD  (0140) |   Area    (ha)=   2.20
|ID= 1 DT= 5.0 min |   Total Imp(%)=  75.00   Dir. Conn.(%)=  75.00
--------------------
                                IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       1.65         0.55
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       2.00         2.00
     Length            (m)=     121.11        40.00
     Mannings n           =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=      67.16        36.99
                over (min)        5.00        15.00
     Storage Coeff.  (min)=       2.73 (ii)   13.24 (ii)
     Unit Hyd. Tpeak (min)=       5.00        15.00
     Unit Hyd. peak  (cms)=       0.29         0.08
                                                          *TOTALS*
     PEAK FLOW       (cms)=       0.31         0.04          0.351 (iii)
     TIME TO PEAK    (hrs)=       2.50         2.58           2.50
     RUNOFF VOLUME    (mm)=      72.00        32.74          62.18
     TOTAL RAINFALL   (mm)=      73.00        73.00          73.00
     RUNOFF COEFFICIENT   =       0.99         0.45           0.85

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB             |
| STANDHYD  (0160) |   Area    (ha)=   0.54
```

```
|ID= 1 DT= 5.0 min |   Total Imp(%)=  75.00   Dir. Conn.(%)=  75.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       0.41         0.14
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       2.00         2.00
     Length            (m)=      60.00        40.00
     Mannings n          =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=      67.16        36.99
                over (min)       5.00        15.00
     Storage Coeff.  (min)=       1.79 (ii)   12.30 (ii)
     Unit Hyd. Tpeak (min)=       5.00        15.00
     Unit Hyd. peak  (cms)=       0.32         0.09
                                                            *TOTALS*
     PEAK FLOW       (cms)=       0.08         0.01           0.086 (iii)
     TIME TO PEAK    (hrs)=       2.50         2.58            2.50
     RUNOFF VOLUME    (mm)=      72.00        32.74           62.17
     TOTAL RAINFALL   (mm)=      73.00        73.00           73.00
     RUNOFF COEFFICIENT   =       0.99         0.45            0.85

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| DUHYD     (0010) |
| Inlet Cap.=0.054 |
| #of Inlets=    1 |
| Total(cms)=  0.1 |      AREA     QPEAK     TPEAK    R.V.
--------------------      (ha)     (cms)     (hrs)    (mm)
     TOTAL HYD.(ID= 1):   0.54      0.09      2.50   62.17
     ==================================================
     MAJOR SYS.(ID= 2):   0.08      0.03      2.50   62.17
     MINOR SYS.(ID= 3):   0.46      0.05      2.08   62.17

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------

--------------------
| ADD HYD   (0005) |
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
          ID1= 1 (0010):     0.08   0.032     2.50    62.17
        + ID2= 2 (0110):     2.89   0.382     2.50    52.37
          ===============================================
          ID = 3 (0005):     2.97   0.414     2.50    52.63

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------

--------------------
| ADD HYD   (0005) |
|   3 +  2 =  1    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
          ID1= 3 (0005):     2.97   0.414     2.50    52.63
        + ID2= 2 (0120):     1.49   0.262     2.50    67.29
          ===============================================
          ID = 1 (0005):     4.46   0.676     2.50    57.53

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------

--------------------
| ADD HYD   (0005) |
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
          ID1= 1 (0005):     4.46   0.676     2.50    57.53
        + ID2= 2 (0130):     0.53   0.058     2.50    46.46
          ===============================================
          ID = 3 (0005):     4.99   0.734     2.50    56.35

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

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--------------------
| ADD HYD   (0005) |
|   3 +  2 =  1    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
          ID1= 3 (0005):      4.99   0.734     2.50    56.35
        + ID2= 2 (0140):      2.20   0.351     2.50    62.18
          ==================================================
          ID = 1 (0005):      7.19   1.085     2.50    58.13

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

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--------------------
| ADD HYD   (0005) |
|   1 +  2 =  3    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
          ID1= 1 (0005):      7.19   1.085     2.50    58.13
        + ID2= 2 (0150):      3.18   0.161     3.00    32.73
          ==================================================
          ID = 3 (0005):     10.37   1.184     2.50    50.35

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR (0006) |
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |      OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------       (cms)     (ha.m.)   |   (cms)     (ha.m.)
                           0.0000     0.0000   |   0.0320      0.1782
                           0.0050     0.0211   |   0.1250      0.2093
                           0.0080     0.0440   |   0.4240      0.2417
                           0.0110     0.0683   |   0.8410      0.2757
                           0.0130     0.0938   |   1.3500      0.3113
                           0.0140     0.1205   |   1.9300      0.3486
                           0.0160     0.1486   |   2.5900      0.3876

                                 AREA     QPEAK     TPEAK       R.V.
                                 (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 2 (0005)     10.370      1.184      2.50      50.35
     OUTFLOW: ID= 1 (0006)     10.370      0.566      2.75      50.24

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)= 47.83
                   TIME SHIFT OF PEAK FLOW         (min)= 15.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=  0.2535

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD  (0011) |   Area    (ha)=   0.00
|ID= 1 DT= 5.0 min |   Total Imp(%)=  50.00   Dir. Conn.(%)=  35.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       0.00         0.00
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=       0.00        40.00
     Mannings n           =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=      67.16        74.93
                over (min)        5.00        10.00
     Storage Coeff.  (min)=       0.00 (ii)    7.92 (ii)
     Unit Hyd. Tpeak (min)=       5.00        10.00
     Unit Hyd. peak  (cms)=       0.34         0.17
                                                            *TOTALS*
     PEAK FLOW       (cms)=       0.00         0.00           0.000 (iii)
     TIME TO PEAK    (hrs)=       0.00         0.00           0.00
     RUNOFF VOLUME    (mm)=    NaN          NaN            NaN
     TOTAL RAINFALL   (mm)=      73.00        73.00          73.00
     RUNOFF COEFFICIENT   =    NaN          NaN            NaN

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 50.00           K  (1/hr)=  2.00
            Fc   (mm/hr)=  7.50     Cum.Inf.   (mm)=  0.00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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| ADD HYD   (0012) |
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
*** W A R N I N G :  HYDROGRAPH 0011 <ID= 2> IS DRY.
*** W A R N I N G :  HYDROGRAPH 0003 = HYDROGRAPH 0001
*** W A R N I N G :  HYDROGRAPH 0003 = HYDROGRAPH 0001
          ID1= 1 (0010):     0.46   0.054     2.08    62.17
        + ID2= 2 (0011):     0.00   0.000     0.00   NaN
          =================================================
          ID = 3 (0012):     0.46   0.054     2.08    62.17

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

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  ****************************
  ** SIMULATION NUMBER:   6 **
  ****************************


--------------------
|    READ STORM    |    Filename: C:\Users\jiantomasi\AppD
|                  |              ata\Local\Temp\
|                  |              0ca6545a-89e5-4cbd-9772-39d4c2518c8e\d387665c
| Ptotal= 80.30 mm |    Comments: Toronto Bloor: 6-hr, 100-yr storm
--------------------
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                 0.25    1.61 |  1.75   27.30 |  3.25   11.24 |  4.75    1.61
                 0.50    1.61 |  2.00   27.30 |  3.50   11.24 |  5.00    1.61
                 0.75    1.61 |  2.25   73.88 |  3.75    6.42 |  5.25    1.61
                 1.00    1.61 |  2.50   73.88 |  4.00    6.42 |  5.50    1.61
                 1.25    9.64 |  2.75   20.88 |  4.25    3.21 |  5.75    1.61
                 1.50    9.64 |  3.00   20.88 |  4.50    3.21 |  6.00    1.61

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--------------------
| CALIB            |
| NASHYD    (0150) |   Area    (ha)=   3.18   Curve Number   (CN)= 75.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   1.50   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.56

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                              ---- TRANSFORMED HYETOGRAPH ----
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.083    1.61 | 1.583   27.30 | 3.083   11.24 |  4.58    1.61
                0.167    1.61 | 1.667   27.30 | 3.167   11.24 |  4.67    1.61
                0.250    1.61 | 1.750   27.30 | 3.250   11.24 |  4.75    1.61
                0.333    1.61 | 1.833   27.30 | 3.333   11.24 |  4.83    1.61
                0.417    1.61 | 1.917   27.30 | 3.417   11.24 |  4.92    1.61
                0.500    1.61 | 2.000   27.30 | 3.500   11.24 |  5.00    1.61
                0.583    1.61 | 2.083   73.88 | 3.583    6.42 |  5.08    1.61
                0.667    1.61 | 2.167   73.88 | 3.667    6.42 |  5.17    1.61
                0.750    1.61 | 2.250   73.88 | 3.750    6.42 |  5.25    1.61
                0.833    1.61 | 2.333   73.88 | 3.833    6.42 |  5.33    1.61
                0.917    1.61 | 2.417   73.88 | 3.917    6.42 |  5.42    1.61
                1.000    1.61 | 2.500   73.88 | 4.000    6.42 |  5.50    1.61
                1.083    9.64 | 2.583   20.88 | 4.083    3.21 |  5.58    1.61
                1.167    9.64 | 2.667   20.88 | 4.167    3.21 |  5.67    1.61
                1.250    9.64 | 2.750   20.88 | 4.250    3.21 |  5.75    1.61
                1.333    9.64 | 2.833   20.88 | 4.333    3.21 |  5.83    1.61
                1.417    9.64 | 2.917   20.88 | 4.417    3.21 |  5.92    1.61
                1.500    9.64 | 3.000   20.88 | 4.500    3.21 |  6.00    1.61

     Unit Hyd Qpeak  (cms)=   0.217

     PEAK FLOW       (cms)=   0.188 (i)
     TIME TO PEAK    (hrs)=   2.917
     RUNOFF VOLUME    (mm)=  37.985
     TOTAL RAINFALL   (mm)=  80.301
     RUNOFF COEFFICIENT   =   0.473

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD  (0110) |   Area    (ha)=   2.89
|ID= 1 DT= 5.0 min |   Total Imp(%)=  50.00   Dir. Conn.(%)=  50.00
--------------------
                            IMPERVIOUS    PERVIOUS (i)
```

```
     Surface Area     (ha)=       1.45          1.45
     Dep. Storage     (mm)=       1.00          1.50
     Average Slope     (%)=       2.00          2.00
     Length            (m)=     138.80         40.00
     Mannings n           =      0.013         0.250

     Max.Eff.Inten.(mm/hr)=      73.88         44.33
                over (min)        5.00         15.00
     Storage Coeff.  (min)=       2.85 (ii)    12.62 (ii)
     Unit Hyd. Tpeak (min)=       5.00         15.00
     Unit Hyd. peak  (cms)=       0.28          0.08
                                                        *TOTALS*
     PEAK FLOW       (cms)=       0.30          0.14          0.430 (iii)
     TIME TO PEAK    (hrs)=       2.50          2.58           2.50
     RUNOFF VOLUME    (mm)=      79.30         37.99          58.64
     TOTAL RAINFALL   (mm)=      80.30         80.30          80.30
     RUNOFF COEFFICIENT   =       0.99          0.47           0.73

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB              |
| STANDHYD  (0120) |   Area    (ha)=   1.49
|ID= 1 DT= 5.0 min |   Total Imp(%)=  88.00   Dir. Conn.(%)=  88.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       1.31          0.18
     Dep. Storage     (mm)=       1.00          1.50
     Average Slope     (%)=       2.00          1.00
     Length            (m)=      99.67         40.00
     Mannings n           =      0.013         0.250

     Max.Eff.Inten.(mm/hr)=      73.88         44.33
                over (min)        5.00         10.00
     Storage Coeff.  (min)=       2.34 (ii)     6.76 (ii)
     Unit Hyd. Tpeak (min)=       5.00         10.00
     Unit Hyd. peak  (cms)=       0.30          0.14
                                                        *TOTALS*
     PEAK FLOW       (cms)=       0.27          0.02          0.289 (iii)
     TIME TO PEAK    (hrs)=       2.50          2.50           2.50
     RUNOFF VOLUME    (mm)=      79.30         37.99          74.34
     TOTAL RAINFALL   (mm)=      80.30         80.30          80.30
     RUNOFF COEFFICIENT   =       0.99          0.47           0.93

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB              |
| STANDHYD  (0130) |   Area    (ha)=   0.53
|ID= 1 DT= 5.0 min |   Total Imp(%)=  35.00   Dir. Conn.(%)=  35.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       0.19          0.34
     Dep. Storage     (mm)=       1.00          1.50
     Average Slope     (%)=       1.00          1.00
     Length            (m)=      59.44         40.00
     Mannings n           =      0.013         0.250

     Max.Eff.Inten.(mm/hr)=      73.88         42.84
                over (min)        5.00         15.00
     Storage Coeff.  (min)=       2.11 (ii)    14.31 (ii)
     Unit Hyd. Tpeak (min)=       5.00         15.00
     Unit Hyd. peak  (cms)=       0.31          0.08
                                                        *TOTALS*
     PEAK FLOW       (cms)=       0.04          0.03          0.069 (iii)
     TIME TO PEAK    (hrs)=       2.50          2.58           2.50
     RUNOFF VOLUME    (mm)=      79.30         37.99          52.43
     TOTAL RAINFALL   (mm)=      80.30         80.30          80.30
     RUNOFF COEFFICIENT   =       0.99          0.47           0.65
```

```
***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB             |
| STANDHYD  (0140) |   Area    (ha)=   2.20
|ID= 1 DT= 5.0 min |   Total Imp(%)=  75.00   Dir. Conn.(%)=  75.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       1.65         0.55
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       2.00         2.00
     Length            (m)=     121.11        40.00
     Mannings n           =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=      73.88        44.33
                over (min)        5.00        15.00
     Storage Coeff.  (min)=       2.63 (ii)   12.40 (ii)
     Unit Hyd. Tpeak (min)=       5.00        15.00
     Unit Hyd. peak  (cms)=       0.29         0.08
                                                              *TOTALS*
     PEAK FLOW       (cms)=       0.34         0.05            0.390 (iii)
     TIME TO PEAK    (hrs)=       2.50         2.58             2.50
     RUNOFF VOLUME    (mm)=      79.30        37.99            68.97
     TOTAL RAINFALL   (mm)=      80.30        80.30            80.30
     RUNOFF COEFFICIENT   =       0.99         0.47             0.86

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB             |
| STANDHYD  (0160) |   Area    (ha)=   0.54
|ID= 1 DT= 5.0 min |   Total Imp(%)=  75.00   Dir. Conn.(%)=  75.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       0.41         0.14
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       2.00         2.00
     Length            (m)=      60.00        40.00
     Mannings n           =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=      73.88        44.33
                over (min)        5.00        15.00
     Storage Coeff.  (min)=       1.72 (ii)   11.50 (ii)
     Unit Hyd. Tpeak (min)=       5.00        15.00
     Unit Hyd. peak  (cms)=       0.32         0.09
                                                              *TOTALS*
     PEAK FLOW       (cms)=       0.08         0.01            0.096 (iii)
     TIME TO PEAK    (hrs)=       2.42         2.58             2.50
     RUNOFF VOLUME    (mm)=      79.30        37.99            68.96
     TOTAL RAINFALL   (mm)=      80.30        80.30            80.30
     RUNOFF COEFFICIENT   =       0.99         0.47             0.86

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| DUHYD     (0010) |
| Inlet Cap.=0.054 |
| #of Inlets=    1 |
| Total(cms)=  0.1 |      AREA     QPEAK     TPEAK    R.V.
--------------------      (ha)     (cms)     (hrs)    (mm)
     TOTAL HYD.(ID= 1):   0.54      0.10      2.50   68.96
     =====================================================
     MAJOR SYS.(ID= 2):   0.10      0.04      2.50   68.96
```

```
     MINOR SYS.(ID= 3):   0.44      0.05      2.08   68.96

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------

--------------------
| ADD HYD   (0005) |
|   1 +  2 =  3    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
          ID1= 1 (0010):      0.10   0.042     2.50    68.96
        + ID2= 2 (0110):      2.89   0.430     2.50    58.64
          ==================================================
          ID = 3 (0005):      2.99   0.472     2.50    58.97

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

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--------------------
| ADD HYD   (0005) |
|   3 +  2 =  1    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
          ID1= 3 (0005):      2.99   0.472     2.50    58.97
        + ID2= 2 (0120):      1.49   0.289     2.50    74.34
          ==================================================
          ID = 1 (0005):      4.48   0.761     2.50    64.09

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------

--------------------
| ADD HYD   (0005) |
|   1 +  2 =  3    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
          ID1= 1 (0005):      4.48   0.761     2.50    64.09
        + ID2= 2 (0130):      0.53   0.069     2.50    52.43
          ==================================================
          ID = 3 (0005):      5.01   0.830     2.50    62.85

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

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--------------------
| ADD HYD   (0005) |
|   3 +  2 =  1    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
          ID1= 3 (0005):      5.01   0.830     2.50    62.85
        + ID2= 2 (0140):      2.20   0.390     2.50    68.97
          ==================================================
          ID = 1 (0005):      7.21   1.220     2.50    64.72

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------

--------------------
| ADD HYD   (0005) |
|   1 +  2 =  3    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
          ID1= 1 (0005):      7.21   1.220     2.50    64.72
        + ID2= 2 (0150):      3.18   0.188     2.92    37.99
          ==================================================
          ID = 3 (0005):     10.39   1.337     2.50    56.54

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR (0006) |
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |      OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------       (cms)     (ha.m.)   |   (cms)     (ha.m.)
                           0.0000     0.0000   |   0.0320      0.1782
                           0.0050     0.0211   |   0.1250      0.2093
                           0.0080     0.0440   |   0.4240      0.2417
                           0.0110     0.0683   |   0.8410      0.2757
                           0.0130     0.0938   |   1.3500      0.3113
                           0.0140     0.1205   |   1.9300      0.3486
                           0.0160     0.1486   |   2.5900      0.3876

                                 AREA      QPEAK      TPEAK        R.V.
```

```
                                (ha)      (cms)     (hrs)       (mm)
     INFLOW : ID= 2 (0005)     10.386      1.337      2.50      56.54
     OUTFLOW: ID= 1 (0006)     10.386      0.743      2.58      56.43

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)= 55.59
                   TIME SHIFT OF PEAK FLOW         (min)=  5.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=  0.2677

--------------------------------------------------------------------------------
--------------------
| CALIB              |
| STANDHYD  (0011) |   Area    (ha)=   0.00
|ID= 1 DT= 5.0 min |   Total Imp(%)=  50.00   Dir. Conn.(%)=  35.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       0.00         0.00
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=       0.00        40.00
     Mannings n           =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=      73.88        83.93
                over (min)        5.00        10.00
     Storage Coeff.  (min)=       0.00 (ii)    7.57 (ii)
     Unit Hyd. Tpeak (min)=       5.00        10.00
     Unit Hyd. peak  (cms)=       0.34         0.17
                                                          *TOTALS*
     PEAK FLOW       (cms)=       0.00         0.00         0.000 (iii)
     TIME TO PEAK    (hrs)=       0.00         0.00          0.00
     RUNOFF VOLUME    (mm)=    NaN          NaN            NaN
     TOTAL RAINFALL   (mm)=      80.30        80.30         80.30
     RUNOFF COEFFICIENT   =    NaN          NaN            NaN

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 50.00          K  (1/hr)=  2.00
            Fc   (mm/hr)=  7.50     Cum.Inf.   (mm)=  0.00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------

--------------------
| ADD HYD   (0012) |
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
*** W A R N I N G :  HYDROGRAPH 0011 <ID= 2> IS DRY.
*** W A R N I N G :  HYDROGRAPH 0003 = HYDROGRAPH 0001
*** W A R N I N G :  HYDROGRAPH 0003 = HYDROGRAPH 0001
          ID1= 1 (0010):     0.44   0.054     2.08    68.96
        + ID2= 2 (0011):     0.00   0.000     0.00   NaN
          =================================================
          ID = 3 (0012):     0.44   0.054     2.08    68.96

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

--------------------------------------------------------------------------------

 FINISH
==============================================================================================================
```

```
================================================================================================

       V    V   I    SSSSS  U   U    A    L
       V    V   I    SS     U   U   A A   L
        V  V    I     SS    U   U  AAAAA  L
        V  V    I      SS   U   U  A   A  L
         VV     I    SSSSS  UUUUU  A   A  LLLLL

        OOO   TTTTT  TTTTT  H   H  Y   Y  M   M   OOO    TM
       O   O    T      T    H   H   Y Y   MM MM  O   O
       O   O    T      T    H   H    Y    M   M  O   O
        OOO     T      T    H   H    Y    M   M   OOO
```

Developed and Distributed by Civica Infrastructure

***** D E T A I L E D   O U T P U T *****

```
  Input   filename: C:\Program Files (x86)\VH Suite 3.0\VO2\voin.dat
  Output  filename: C:\Users\smsexton\AppData\Local\Temp\25f4cca4-79bc-441e-b96f-3432ac038f7e\Scenario.out
  Summary filename: C:\Users\smsexton\AppData\Local\Temp\25f4cca4-79bc-441e-b96f-3432ac038f7e\Scenario.sum


DATE: 07/17/2017                          TIME: 10:27:24

USER:



COMMENTS: ____________________________________________________________


------------------------------------------------------------------------------------------------
  ****************************
  ** SIMULATION NUMBER:   8 **
  ****************************


--------------------
|    READ STORM    |    Filename: C:\Users\smsexton\AppD
|                  |              ata\Local\Temp\
|                  |              25f4cca4-79bc-441e-b96f-3432ac038f7e\2b887e11
| Ptotal= 25.00 mm |    Comments: TWENTY-FIVE MM FOUR HR CHICAGO STORM WIT
--------------------
```

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.17	2.07	1.17	5.70	2.17	5.19	3.17	2.80
0.33	2.27	1.33	10.78	2.33	4.47	3.33	2.62
0.50	2.52	1.50	50.21	2.50	3.95	3.50	2.48
0.67	2.88	1.67	13.37	2.67	3.56	3.67	2.35
0.83	3.38	1.83	8.29	2.83	3.25	3.83	2.23
1.00	4.18	2.00	6.30	3.00	3.01	4.00	2.14

```
--------------------------------------------------------------------------------

--------------------
| CALIB            |
| NASHYD    (0150) |   Area    (ha)=   3.18   Curve Number   (CN)= 75.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   1.50   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.56

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.
```

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.083	2.07	1.083	5.70	2.083	5.19	3.08	2.80
0.167	2.07	1.167	5.70	2.167	5.19	3.17	2.80
0.250	2.27	1.250	10.78	2.250	4.47	3.25	2.62
0.333	2.27	1.333	10.78	2.333	4.47	3.33	2.62
0.417	2.52	1.417	50.21	2.417	3.95	3.42	2.48
0.500	2.52	1.500	50.21	2.500	3.95	3.50	2.48
0.583	2.88	1.583	13.37	2.583	3.56	3.58	2.35
0.667	2.88	1.667	13.37	2.667	3.56	3.67	2.35
0.750	3.38	1.750	8.29	2.750	3.25	3.75	2.23
0.833	3.38	1.833	8.29	2.833	3.25	3.83	2.23
0.917	4.17	1.917	6.30	2.917	3.01	3.92	2.14
1.000	4.18	2.000	6.29	3.000	3.01	4.00	2.14

Unit Hyd Qpeak (cms)=   0.217

```
     PEAK FLOW       (cms)=   0.022 (i)
     TIME TO PEAK    (hrs)=   2.167
     RUNOFF VOLUME    (mm)=   5.103
     TOTAL RAINFALL   (mm)=  24.996
     RUNOFF COEFFICIENT   =   0.204

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB              |
| STANDHYD  (0110) |   Area    (ha)=   2.89
|ID= 1 DT= 5.0 min |   Total Imp(%)=  50.00   Dir. Conn.(%)=  50.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       1.45         1.45
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       2.00         2.00
     Length            (m)=     138.80        40.00
     Mannings n           =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=      50.21         5.24
                over (min)        5.00        30.00
     Storage Coeff.  (min)=       3.33 (ii)   26.29 (ii)
     Unit Hyd. Tpeak (min)=       5.00        30.00
     Unit Hyd. peak  (cms)=       0.26         0.04
                                                            *TOTALS*
     PEAK FLOW       (cms)=       0.19         0.01           0.196 (iii)
     TIME TO PEAK    (hrs)=       1.50         1.92            1.50
     RUNOFF VOLUME    (mm)=      24.00         5.10           14.54
     TOTAL RAINFALL   (mm)=      25.00        25.00           25.00
     RUNOFF COEFFICIENT   =       0.96         0.20            0.58

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB              |
| STANDHYD  (0120) |   Area    (ha)=   1.49
|ID= 1 DT= 5.0 min |   Total Imp(%)=  88.00   Dir. Conn.(%)=  88.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       1.31         0.18
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       2.00         1.00
     Length            (m)=      99.67        40.00
     Mannings n           =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=      50.21         4.76
                over (min)        5.00        35.00
     Storage Coeff.  (min)=       2.73 (ii)   32.09 (ii)
     Unit Hyd. Tpeak (min)=       5.00        35.00
     Unit Hyd. peak  (cms)=       0.29         0.03
                                                            *TOTALS*
     PEAK FLOW       (cms)=       0.18         0.00           0.179 (iii)
     TIME TO PEAK    (hrs)=       1.50         2.00            1.50
     RUNOFF VOLUME    (mm)=      24.00         5.10           21.72
     TOTAL RAINFALL   (mm)=      25.00        25.00           25.00
     RUNOFF COEFFICIENT   =       0.96         0.20            0.87

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB              |
| STANDHYD  (0130) |   Area    (ha)=   0.53
|ID= 1 DT= 5.0 min |   Total Imp(%)=  35.00   Dir. Conn.(%)=  35.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       0.19         0.34
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         1.00
```

```
     Length            (m)=      59.44        40.00
     Mannings n           =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=      50.21         4.76
                over (min)        5.00        35.00
     Storage Coeff.  (min)=       2.46 (ii)   31.82 (ii)
     Unit Hyd. Tpeak (min)=       5.00        35.00
     Unit Hyd. peak  (cms)=       0.30         0.03
                                                              *TOTALS*
     PEAK FLOW       (cms)=       0.03         0.00            0.026 (iii)
     TIME TO PEAK    (hrs)=       1.50         2.00             1.50
     RUNOFF VOLUME    (mm)=      24.00         5.10            11.68
     TOTAL RAINFALL   (mm)=      25.00        25.00            25.00
     RUNOFF COEFFICIENT   =       0.96         0.20             0.47

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB              |
| STANDHYD  (0140) |   Area    (ha)=   2.20
|ID= 1 DT= 5.0 min |   Total Imp(%)=  75.00   Dir. Conn.(%)=  75.00
--------------------
                                IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       1.65         0.55
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       2.00         2.00
     Length            (m)=     121.11        40.00
     Mannings n           =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=      50.21         5.24
                over (min)        5.00        30.00
     Storage Coeff.  (min)=       3.07 (ii)   26.03 (ii)
     Unit Hyd. Tpeak (min)=       5.00        30.00
     Unit Hyd. peak  (cms)=       0.27         0.04
                                                              *TOTALS*
     PEAK FLOW       (cms)=       0.22         0.00            0.224 (iii)
     TIME TO PEAK    (hrs)=       1.50         1.92             1.50
     RUNOFF VOLUME    (mm)=      24.00         5.10            19.27
     TOTAL RAINFALL   (mm)=      25.00        25.00            25.00
     RUNOFF COEFFICIENT   =       0.96         0.20             0.77

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB              |
| STANDHYD  (0160) |   Area    (ha)=   0.54
|ID= 1 DT= 5.0 min |   Total Imp(%)=  75.00   Dir. Conn.(%)=  75.00
--------------------
                                IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       0.41         0.14
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       2.00         2.00
     Length            (m)=      60.00        40.00
     Mannings n           =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=      50.21         5.24
                over (min)        5.00        25.00
     Storage Coeff.  (min)=       2.01 (ii)   24.97 (ii)
     Unit Hyd. Tpeak (min)=       5.00        25.00
     Unit Hyd. peak  (cms)=       0.31         0.05
                                                              *TOTALS*
     PEAK FLOW       (cms)=       0.06         0.00            0.057 (iii)
     TIME TO PEAK    (hrs)=       1.50         1.83             1.50
     RUNOFF VOLUME    (mm)=      24.00         5.10            19.25
     TOTAL RAINFALL   (mm)=      25.00        25.00            25.00
     RUNOFF COEFFICIENT   =       0.96         0.20             0.77

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
```

```
           CN*  =  75.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 ------------------------------------------------------------------------------
 --------------------
 | DUHYD     (0010) |
 | Inlet Cap.=0.054 |
 | #of Inlets=    1 |
 | Total(cms)=  0.1 |       AREA     QPEAK     TPEAK    R.V.
 --------------------       (ha)     (cms)     (hrs)    (mm)
      TOTAL HYD.(ID= 1):   0.54      0.06      1.50   19.25
      =====================================================
      MAJOR SYS.(ID= 2):   0.00      0.00      1.50   19.25
      MINOR SYS.(ID= 3):   0.54      0.05      1.50   19.25

      NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 ------------------------------------------------------------------------------

 --------------------
 | ADD HYD   (0005) |
 |   1 +  2 =  3    |          AREA    QPEAK    TPEAK     R.V.
 --------------------          (ha)    (cms)    (hrs)     (mm)
           ID1= 1 (0010):      0.00   0.003     1.50    19.25
         + ID2= 2 (0110):      2.89   0.196     1.50    14.54
           ================================================
           ID = 3 (0005):      2.89   0.199     1.50    14.55

      NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 ------------------------------------------------------------------------------

 --------------------
 | ADD HYD   (0005) |
 |   3 +  2 =  1    |          AREA    QPEAK    TPEAK     R.V.
 --------------------          (ha)    (cms)    (hrs)     (mm)
           ID1= 3 (0005):      2.89   0.199     1.50    14.55
         + ID2= 2 (0120):      1.49   0.179     1.50    21.72
           ================================================
           ID = 1 (0005):      4.38   0.378     1.50    16.99

      NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 ------------------------------------------------------------------------------

 --------------------
 | ADD HYD   (0005) |
 |   1 +  2 =  3    |          AREA    QPEAK    TPEAK     R.V.
 --------------------          (ha)    (cms)    (hrs)     (mm)
           ID1= 1 (0005):      4.38   0.378     1.50    16.99
         + ID2= 2 (0130):      0.53   0.026     1.50    11.68
           ================================================
           ID = 3 (0005):      4.91   0.404     1.50    16.41

      NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 ------------------------------------------------------------------------------

 --------------------
 | ADD HYD   (0005) |
 |   3 +  2 =  1    |          AREA    QPEAK    TPEAK     R.V.
 --------------------          (ha)    (cms)    (hrs)     (mm)
           ID1= 3 (0005):      4.91   0.404     1.50    16.41
         + ID2= 2 (0140):      2.20   0.224     1.50    19.27
           ================================================
           ID = 1 (0005):      7.11   0.628     1.50    17.30

      NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

 ------------------------------------------------------------------------------

 --------------------
 | ADD HYD   (0005) |
 |   1 +  2 =  3    |          AREA    QPEAK    TPEAK     R.V.
 --------------------          (ha)    (cms)    (hrs)     (mm)
           ID1= 1 (0005):      7.11   0.628     1.50    17.30
         + ID2= 2 (0150):      3.18   0.022     2.17     5.10
           ================================================
           ID = 3 (0005):     10.29   0.632     1.50    13.53

      NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
```

```
--------------------------------------------------------------------------------
--------------------
| RESERVOIR (0006) |
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |   0.0320      0.1782
                          0.0050     0.0211   |   0.1250      0.2093
                          0.0080     0.0440   |   0.4240      0.2417
                          0.0110     0.0683   |   0.8410      0.2757
                          0.0130     0.0938   |   1.3500      0.3113
                          0.0140     0.1205   |   1.9300      0.3486
                          0.0160     0.1486   |   2.5900      0.3876

                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
     INFLOW : ID= 2 (0005)     10.294      0.632      1.50      13.53
     OUTFLOW: ID= 1 (0006)     10.294      0.014      4.25      13.43

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=  2.24
                   TIME SHIFT OF PEAK FLOW         (min)=165.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=  0.1229

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD  (0011) |   Area    (ha)=   0.00
|ID= 1 DT= 5.0 min |   Total Imp(%)=  50.00   Dir. Conn.(%)=  35.00
--------------------
                               IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       0.00         0.00
     Dep. Storage     (mm)=       1.00         1.50
     Average Slope     (%)=       1.00         2.00
     Length            (m)=       0.00        40.00
     Mannings n           =      0.013        0.250

     Max.Eff.Inten.(mm/hr)=      50.21        15.29
                over (min)        5.00        15.00
     Storage Coeff.  (min)=       0.00 (ii)   14.96 (ii)
     Unit Hyd. Tpeak (min)=       5.00        15.00
     Unit Hyd. peak  (cms)=       0.34         0.13
                                                             *TOTALS*
     PEAK FLOW       (cms)=       0.00         0.00           0.000 (iii)
     TIME TO PEAK    (hrs)=       0.00         0.00            0.00
     RUNOFF VOLUME    (mm)=    NaN          NaN            NaN
     TOTAL RAINFALL   (mm)=      25.00        25.00           25.00
     RUNOFF COEFFICIENT   =    NaN          NaN            NaN

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 50.00           K  (1/hr)=  2.00
            Fc   (mm/hr)=  7.50     Cum.Inf.   (mm)=  0.00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------

--------------------
| ADD HYD   (0012) |
|   1 +  2 =  3    |          AREA    QPEAK    TPEAK     R.V.
--------------------          (ha)    (cms)    (hrs)     (mm)
*** W A R N I N G :  HYDROGRAPH 0011 <ID= 2> IS DRY.
*** W A R N I N G :  HYDROGRAPH 0003 = HYDROGRAPH 0001
*** W A R N I N G :  HYDROGRAPH 0003 = HYDROGRAPH 0001
          ID1= 1 (0010):     0.54   0.054     1.50    19.25
        + ID2= 2 (0011):     0.00   0.000     0.00   NaN
          ==================================================
          ID = 3 (0012):     0.54   0.054     1.50    19.25

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

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Appendix C
SWM Shield Product Information

CB SHIELD INC.

233 Cross Avenue, Suite 302
Oakville, ON L6J 2W9, Canada
(T) 519-212-9161
info@cbshield.com

File: GHD-101

March 7, 2017

GHD Whitby
65 Sunray Street
Whitby ON L1N 8Y3

Attention: Jamie Iantomasi, P. Eng.
Water Resource Engineer

Reference: Region of Peel SWM Facilities Retrofit, GHD # 11129100
Predicted Performance of SWM Shield Units

Dear Jamie:

As requested, we are providing you with sizing and predicted performance information for your consideration in implementing SWM Shield™ stormwater devices at existing SWM facility retrofits at Heart Lake Road/Mayfield Road and Kennedy Road/Mayfield Road in the City of Brampton, Region of Peel. We understand the two SWM facilities, which are owned and operated by the Region of Peel, are undergoing retrofits that will be designed by GHD.

The sizing of these devices, as you are aware, is based on ETV testing originally completed for the CB Shield™. Our scaling of the much smaller CB Shield device up to the SWM Shield size will be outlined in this letter, and will include an important statement regarding the potential limitations of that scaling. We are quite aware that the scaling involved will require confirmation through testing, and therefore we cannot support claims of performance with the same certainty as our smaller ETV verified CB Shield device. However, we are confident that theoretical calculations will provide good general expectations of performance for the two proposed units.

Site Parameters

We have based our review on the catchment parameters provided for the Heart Lake Road/Mayfield and Kennedy Road/Mayfield Road SWM facilities as follows:

Heart Lake Facility: Area = 10.29 ha
Imperviousness = 45%

Kennedy Facility: Area = 9.02 ha
Imperviousness = 58%

Initial Sizing of the SWM Shields

SWM Shield sizing is based on treatment principles determined through ETV testing and verification completed for the CB Shield. Accordingly, a first approximation at sizing any given SWM Shield relates back to the average number of catch basins that would be found in a similar catchment area. The approximate the number of catch basins in a residential catchment can be roughly estimated using a ratio of 5 CB's per hectare, which is typical for residential areas. This allows a quick determination of treatment surface area as follows:

- SWM Shield Area (m^2) = Area of CB Shield grate (m^2) X 5 CB's/ha X Total Site Area (ha)
- SWM Shield Area = 0.36 m^2/CB X 5 CB's/ha X Total Site Area (ha)

In the case of the Heart Lake Facility the approximate the number of catch basins that would typically be in a catchment area of this size can be determined as:

- 10.29 ha X 5 CB's/ha = 51.5 CB's

With this translating to a cumulative treatment area approximation of:

- Heart Lake SWM Shield treatment area (m^2) = 51.5 CB Shields X 0.36 m^2/CB Shield
  = **18.5 m^2**

This initial approximation allows a corresponding number of standard precast lengths to be determined that would provide the required surface area. Each standard length of SWM Shield grate is typically:

- 3.0 m X 2.5 m = 7.5 m^2 per section, with this calculation corresponding to the standard concrete box section used most often - approximately 10 feet by 8 feet.

Calculating the approximate number of box sections required for the Heart Lake SWM Shield:

- 18.5 m^2 / 7.5 m^2/box section = 2.5 box sections

Given the economies of working with whole box sections and to also ensure some additional conservativeness in design, rounding up to 3 whole box sections is warranted.

Similar calculations for the Kennedy Facility yields the same 3 whole sections as its preliminary size.

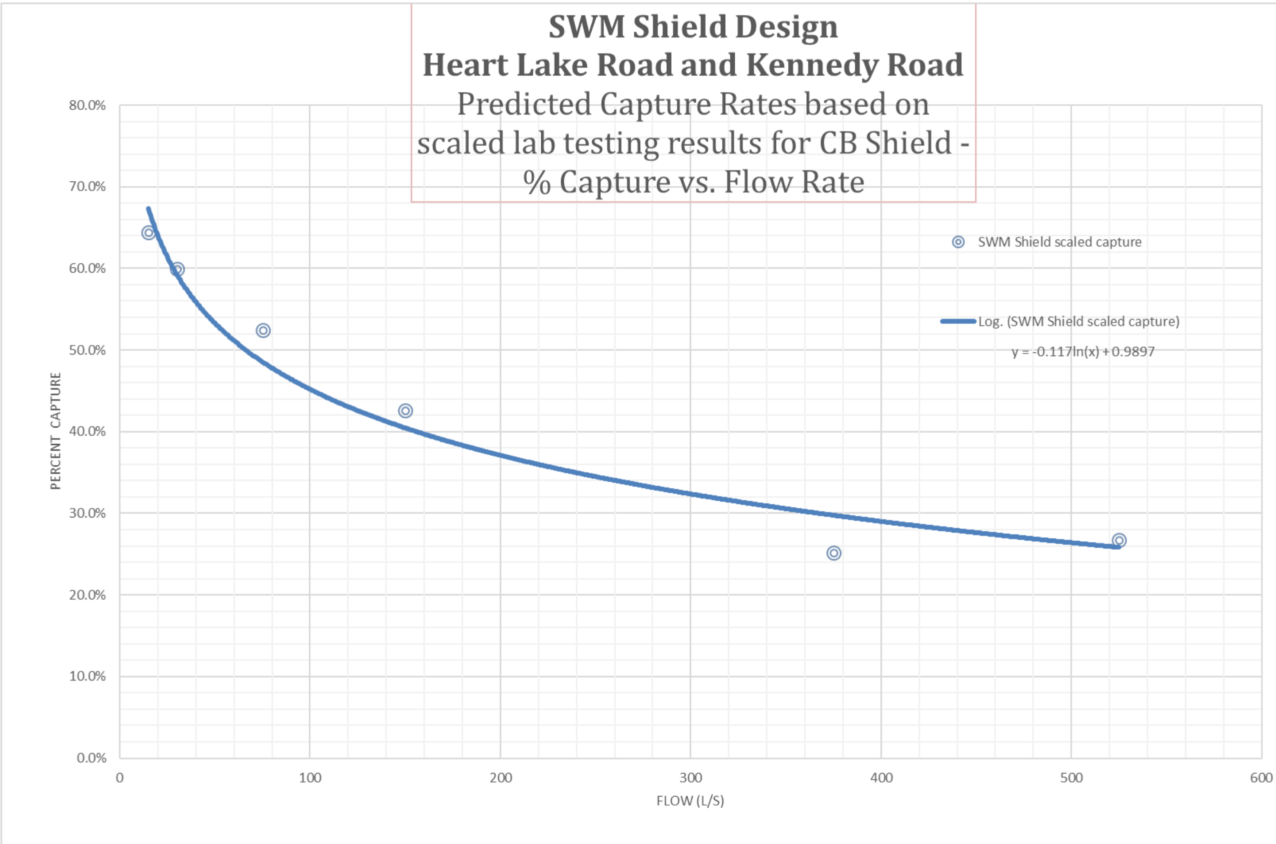
The total surface area associated with each SWM Shield is then calculated as: 3 X 7.5 = **22.5 m^2**

Detailed Sizing and Scaling Discussion

SWM shield predicted performance is based on a scaled version of the CB Shield's removal performance testing results as contained in CB Shield's ETV Verified Performance Claim. The scaling of performance data is made based on total treatment area of surface loading, which in this case is the area of grate. The grate is in contact with permanent water in the sump below during flow events, with sediment removed from the flow stream by gravity settling. Settled particles then proceed further through the grate and into the sump where it is stored until the unit is maintained.

The SWM Shield is also expected to mimic performance of the CB Shield with respect to its anti-scour properties. The similar grate type design combined with a greater depth of sump allows for an expectation that scour will be limited from the SWM Shield even during extreme flow events.

The following chart outlines a flow vs. capture ratio in the proposed SWM Shield model that will be implemented at both of the sites:



Data points in the capture curve above are identical to those contained in the ETV Verified claim for CB Shield except that the flow values have been increased by a factor of 62.5, which is the exact factor of increase in the surface area of the proposed SWM Shield as compared with a standard CB Shield.

It should be noted that the proposed SWM Shield has a sump depth that is only 4 times deeper than that of the standard CB Shield (i.e. 2.4 m vs. 0.6 m depth). However, this difference in depth is not predicted to affect performance other than affecting the cycle of maintenance which is outlined later in this brief.

Predicted Performance

Each of the catchment areas was modelled in PCSWMM, using long term continuous rainfall data from the Bloor Street meteorological station. From this, various flow rates were determined corresponding to their average annual percentage of total volume of flow. This flow was then matched against the corresponding removal rate for the SWM Shield, as determined through scaling from a CB Shield ETV Verified testing data.

If required, the simple approach outlined above can be supplemented through more advanced water quality modelling (within PCSWMM) of the catchments and the SWM Shield treatment devices. Additional modeling would target better description of sediment transport characteristics from the catchments and the associated variation with flows.

Our initial analyses for each of the two SWM Shields indicate similar predicted long term capture of sediment in each unit, due to their similar catchment characteristics. Each unit's predicted long term capture is outlined in the charts below:

Heart Lake Road SWM Shield Predicted Performance			
Flow (L/s)	Average Annual % of Flow	% Capture per Scaled Lab Results	Cumulative Annual Capture
5	21	64%	14%
15	45	64%	15%
25	60	61%	9%
50	77	53%	9%
100	88	45%	5%
150	92	40%	2%
200	94	37%	1%
		TOTAL:	**55%**

Kennedy Road SWM Shield Predicted Performance			
Flow (L/s)	Average Annual % of Flow	% Capture per Scaled Lab Results	Cumulative Annual Capture
5	20	64%	13%
15	43	64%	15%
25	57	61%	9%
50	74	53%	9%
100	87	45%	6%
150	92	40%	2%
200	94	37%	1%
		TOTAL:	**54%**

Maintenance Cycle

Frequency of maintenance will be a function of total stormwater volume directed to each SWM Shield, the loading within the stormwater, and the capture rate of the SWM Shield.

Total volume of stormwater and loading annually directed to each device (on average) is calculated given:

- Approximately 792 mm of precipitation for City of Toronto
- For imperviousness values of 45% and 58%, average precipitation to runoff is estimated at 50% and 60% respectively.
- Stormwater is assumed to contain 125 mg/L of total suspended solids.
- Sediment from stormwater is assumed to have a density of 1.23 kg/L (per MOECC)

Volume of Sediment Captured Calculations:

Heart Lake Road catchment:

- Sediment loading (kg/yr) = 10.29 ha X 792 mm X 50% runoff X 125 mg/L
- Sediment loading (kg/yr) = 5,094 kg/year
- Sediment capture = 5,094 kg/year X 55% capture rate = 2802 kg/year
- Sediment volume captured = 2802 kg/year / 1.23 kg/L = 2.3 m^3/year

Kennedy Road catchment:

- Sediment loading (kg/yr) = 9.02 ha X 792 mm X 60% runoff X 125 mg/L
- Sediment loading (kg/yr) = 5,358 kg/year
- Sediment capture = 5,358 kg/year X 54% capture rate = 2893 kg/year
- Sediment volume = 2893 kg/year / 1.23 kg/L = 2.4 m^3/year

A quick comparison with the MOECC 2003 Guideline document (Table 6.3 reproduced below) indicates a higher predicted loading rate using Table 6.3:

Table 6.3: Annual Sediment Loadings

Catchment Imperviousness	Annual Loading (kg/ha)	Wet Density (kg/m^3)	Annual Loading (m^3/ha)
35%	770	1,230	0.6
55%	2,300	1,230	1.9
70%	3,495	1,230	2.8
85%	4,680	1,230	3.8

SWM Planning & Design Manual - 6-13 - *Operation, Maintenance and Monitoring*

Heart Lake Road catchment using MOECC:

- Annual sediment loading (kg/yr) = 1,535 kg/ha X 10.29 ha = 15,795 kg/year
- Annual sediment captured = 15,795 kg/yr X 55% capture rate = 8,687 kg/year

- Sediment volume captured = 8687 kg/yr / 1.23 kg/L = 7.0 m^3/year

Kennedy Road catchment using MOECC:

- Annual sediment loading (kg/yr) = 2,539 kg/ha X 9.02 ha = 22,902 kg/year
- Annual sediment captured = 22,902 kg/yr X 54% capture rate = 12,367 kg/year
- Sediment volume captured = 12,367 kg/yr / 1.23 kg/L = 10.0 m^3/year

Given the proposed SWM Shield configuration for both locations has a sediment holding capacity (prior to maintenance requirement) of approximately 40 m^3, corresponding to a depth of 1.8 m of the total available sump of 2.4 m. Accordingly, each facility should be expected to be maintained as follows:

- Heart Lake Road Facility maintained every 40m^3 / 7 m^3/year = 5.7 years
- Kennedy Road Facility maintained every 40m^3 / 10 m^3/year = 4 years

Actual accumulation of sediment should be determined through an annual maintenance check. In them interim, we would recommend consideration of the higher MOECC Table 6.3 based loadings.

Closure

Please note that we would be pleased to assist with pursuing approvals you may require from the Ontario Ministry of Environment and Climate Change (MOECC), Toronto Region Conservation Authority (TRCA) and others as may be required.

In summary, we are able to predict at least a 50% long term average removal of sediment from runoff in both the Heart Lake Road and Kennedy Road SWM facilities given installation of suitably sized SWM Shield units. Maintenance cycles for the SWM Shield will be approximately 4 to 6 years.

In closing, we would be happy to provide any further details required. Please feel free to contact me at your convenience.

Thank you.

Yours very truly,
CB Shield Inc.

Stephen Braun

Stephen Braun, P.Eng.
Engineering Director
stephen.braun@cbshield.com

SWM Shield Storm Water Quality System
DESIGN CRITERIA AND SPECIFICATIONS

Description
Water quality system located in a pond at the inlet which may replace sediment fore-bay. Sediment enters the box culvert tank through slotted openings in the top slab.

General Design

- SWM Shield systems are designed to capture sediment before it can enter the pond. At least 90% of all runoff will pass over the entire slotted roof slab before entering the pond. At least 50% of the total suspended solids will be captured by the SWM Shield in a standard design (based on ETV particle size distribution)
- Sediment removal will be project specific and the design performance will be supplied by CB Shield staff.
- Systems are precast concrete box culvert as per OPSS 1821.
- SWM Shield is not designed for traffic loading due to a large number of slotted openings in the top slab. It has walls on each side of the top slab to contain the water and keep vehicles off. If safety concerns exist, a grate may be required to cover the entire top slab.
- SWM Shield is installed on a minimum of 6 inches of ¾ inch aggregate stone with a minimum soil bearing capacity of 2,000 psf. This may vary depending on the pond bed stability and will be left to the engineer's discretion.
- All joints of the SWM Shield system **must be water tight** so water does not leak in/out of the system during cleaning or normal operation. It is therefore the contractor's responsibility to add extra waterproofing in addition to what is supplied by the SWM Shield manufacturer. There are a number of products on the market to achieve this.
- The invert of the pipe out letting into the pond must be equal to or higher than the top of the SWM Shield system. The SWM Shield is best designed when the top slab is 350mm higher than the pond level. If that is not possible another option in the end of system design is available.
- Upon request during the design process an oil baffle or sock may be included to treat dry weather spills.
- Upon request and prior to project initiation, photo documentation of the system installation can be supplied.

INSPECTION AND MAINTENANCE REQUIREMENTS

- The system is designed to be in the pond with an adjacent access road. The outside wall on top of the system will be 900mm high. The inside wall which is open to the pond is 600mm high. This is to allow large storms to spill over the inside wall directly into the pond when necessary.
- The units will be accessible for inspection and cleaning through a manhole frame and cover every 2.5m. Units should be cleaned when the average depth of sediment inside the system is 1800mm. (This for the standard 3000 x 2400mm size) We recommend yearly inspections until a pattern for sediment loading is established.
- Systems can be cleaned by using a vacuum truck. A pressure water hose forcing all sediment to one end of the system may also be helpful. The units may be entered by persons trained in confined space entry.
- Water can be decanted from the SWM Shield tank directly into the pond, leaving only the sediment for the vacuum truck to remove and dispose of.

Appendix D
Ecological Impact Memo

Memorandum

April 28, 2017

To:	John Nemeth, Region of Peel	Ref. No.:	11129100
From:	Heather Polan/ks/3		
CC:	Karen Edgington, GHD; Jamie Iantomasi, GHD Derek Morningstar, GHD		
Subject:	**Natural Environment Existing Conditions** **Kennedy Pond – Stormwater** **City of Brampton, Peel Region**		

1. Introduction

The Region of Peel (Region) retained GHD Limited (GHD) to complete a review of the Kennedy Stormwater Management (SWM) Facility for the purposes of improving the performance of the SWM Facility, as appropriate. The Kennedy SWM facility is located at the northeast corner of the Mayfield Road and Kennedy Road intersection (Site), City of Brampton, Region of Peel. The Region also requested that design alternatives be investigated to look for ways to improve the ease and efficiency of pond maintenance. This Natural Environment Existing Conditions report has been prepared to describe the characteristics of the terrestrial and aquatic environment associated with the SWM Pond in advance of those improvement designs.

2. Study Area

From a natural environment perspective, the characterization of existing conditions within the Study Area are depicted on Figure 1. The Study Area has been defined as the SWM facility (Site) parcel plus a 120-metre (m) buffer. General photos of the Study Area are provided in Appendix A.

3. Methodology

Information on the natural environment existing conditions within the Study Area was gathered from a combination of secondary source material, agency consultation and several Site visits.

3.1 Secondary Source Information Collection and Review

Available secondary sources of information were collected and reviewed to determine the existing natural environment conditions within the Study Area. The sources reviewed are outlined in Table 1.

Table 1 Secondary Source Information Reviewed

Source	Information reviewed
Ministry of Natural Resources and Forestry (MNRF)	• Species at Risk (SAR) • Natural Heritage Information Center (NHIC) mapping • Natural Heritage Features data layers from Land Information Ontario
Fisheries and Oceans Canada (DFO)	• Species at Risk Fish and Mussel Maps (2015)
Ontario Breeding Bird Atlas	• Breeding Bird Data for Study Area
Region of Peel Official Plan (Working Office Consolidation October 2014)	• Schedule A – Core Areas of the Greenlands Systems in Peel • Schedule D1 – Oak Ridges Moraine Conservation Plan Area (ORMCPA) Land Use Designations • Figure 2 – Selected Areas of Provincial Interest
iNaturalist	• Plant and animal observations in vicinity of Study Area
Ontario Reptile and Amphibian Atlas	• Species records for Study Area
Ontario Butterfly Atlas	• Species records for Study Area
eBird	• Avian species records in vicinity of Study Area
Government of Canada	• The Atlas of Canada – Toporama
Rare Vascular Plants of Ontario	• Checked rare plant records for the Peel Region
Atlas of the Mammals of Ontario	• Checked for records of rare mammals in the general area
Bat Conservation International	• Checked range maps in species profiles for the four listed bat species that occur in Ontario
Species at Risk of Ontario List (SARO)	• Checked range maps for SAR species not included in other atlases
Alvars of Ontario	• Checked for any known alvars in the general area
Tallgrass Ontario	• Checked for any known tallgrass prairies, savannahs and indicator species
Toronto and Region Conservation Authority (TRCA)	• Met with the TRCA onsite to discuss constraints
Greenbelt Plan Area	• Checked mapping to determine if the Study Area intersects with the Greenbelt Plan Area
Niagara Escarpment Plan Area	• Checked mapping to determine if the Study Area intersects with the Niagara Escarpment Plan Area
Oak Ridges Moraine Plan Area	• Checked mapping to determine if the Study Area intersects with the Oak Ridges Moraine Plan Area

3.2 Agency Consultation

The Aurora District MNRF was consulted on October 24, 2016 to request available natural heritage information, Species at Risk (SAR) records, and relevant wildlife records. A response was received on March 7, 2017, the results of which are detailed in Section 4.6. During a Site visit on October 26, 2016 and CVC meeting on November 30, 2016, GHD discussed with TRCA the property boundaries and the potential permitting requirements. TRCA also expressed the need to maintain wetland function at the site.

3.3 Site Visits

A Site visit by a qualified ecologist was conducted on October 26, 2016, with the purpose of determining natural environment conditions within the Study Area, and to supplement the results of the secondary source review. Particular attention was paid to the habitat that could be provided for SAR, and a list of incidental wildlife and plants was collected.

Furthermore, surveys for the federally threatened western chorus frog (*Pseudacris triseriata*) were conducted on April 5, April 10, and April 13, 2017, according to applicable protocols available at the time of survey, due to the potential for federal funding for portions of the project.

4. Characterization of the Existing Environment

4.1 Surrounding Land Use

The Study Area falls at the edge of the City of Brampton, part of a wetland area between remnant agricultural fields and across from residential development.

4.2 Significant Natural Features

There are no significant natural features within the Study Area, but the Study Area does fall within the regulation limits of the TRCA's Ontario Regulation 166/06: Development, Interference with Wetlands and Alterations to Shorelines and Watercourses.

The Study Area does not fall within the Oak Ridges Moraine, Niagara Escarpment Plan Area or Greenbelt Plan Area.

4.3 Terrestrial Environment

The SWM pond is at the northeast corner of the intersection, but is adjacent to a wetland feature that runs along Mayfield Road. The SWM pond is surrounded by emergent wetland vegetation, primarily narrow-leaved cattails (*Typha angustifolia*). The cultural meadow surrounding the pond is mostly goldenrod species (*Solidago sp.*) and European grasses with some growth of invasive shrubs. A small, young coniferous plantation is to the north of the SWM ponds and a cattail marsh is to the northeast. The wetlands along Mayfield Road are not classified as provincially significant, but are likely unevaluated.

A list of vegetation and wildlife observed during the Site visit is provided in Appendix B; more detail on the potential for SAR is provided in Section 4.6.

4.4 Aquatic Environment

There does not appear to be any direct flow between the SWM pond and the adjacent wetlands, and there was no distinguished channel although mapping from LIO indicate that there may be a channel through the wetland towards the inline pond to the northeast of the Study Area.

While no fish were observed during the Site visits, SWM ponds often become inhabited by fish from adjacent natural sources or through unlawful introductions. Fish eggs are occasionally transferred via migratory waterfowl into adjacent waterbodies and some of the eggs survive and develop; or humans release aquarium fish into SWM ponds. Common SWM pond species found in the greater Toronto area would include small, common minnows such as creek chub (*Semotilus atromaculatus*), fathead minnow

(*Pimephales promelas*), goldfish (*Carassius auratus*); or pumpkinseed (*Lepomis gibbosus*). These species are able to tolerate the warmer lentic water temperatures and eutrophic conditions of SWM ponds. Endangered redside dace (*Clinostomus elongatus*), found in streams in the vicinity of the study site, would not be able to survive under these conditions, and therefore there are no concerns of encountering this SAR in the SWM Pond.

Redside dace are reported to most often reside in headwater streams, in areas of clear, cool, slow-flowing water with riffle-pool sequences and overhanging vegetation (RDRT, 2010; Scott and Crossman, 1973; COSEWIC, 2007). Riffles are generally used for spawning and pools are used as resident habitat. Habitat temperatures are usually less than 24°C and dissolved oxygen concentrations are at least 7 milligrams per litre (RDRT, 2010). Bottom substrate most often includes boulders, gravel, rock, or sand with a shallow surface covering of detritus or silt (RDRT, 2010). Although they are typically found in clear water, they have been found to tolerate moderate levels of turbidity (COSEWIC, 2007). Redside dace are considered sensitive to turbidity, as the bulk of their ingested food consists of terrestrial insects captured through a jumping-out-of-water feeding method; cloudy waters hinder vision and capture of insects (Scott and Crossman, 1973). Important habitat elements include overhanging riparian vegetation (grasses and shrubs), undercut banks, and instream cover in the form of boulders and woody debris (COSEWIC, 2007). Unless spawning, they are reported to prefer residing in pools from 0.1 to 2.0 m in depth. Spawning occurs in shallow gravel riffles. Redside dace eggs are non-adhesive and therefore vulnerable to high flows; instream cover in the form of submerged branches and logs, aquatic vegetation, and rocks can control the velocities of flow which easily wash away eggs (Scott and Crossman, 1973).

Under the DFO Self Assessment process, the two main criteria for assessment are Waterbody Type and Activity Type and their associated criteria. The SWM ponds satisfy the Waterbody Type exemption for DFO review as they are existing artificial waterbodies that are not connected to a waterbody that contain fish at any time during any given year. As the fishery of the ponds are unknown at this time, it is still required to avoid causing serious harm to fish by adhering to best management practices, such as those described in the measures to avoid harm under the Fisheries Act. If fish are found in the ponds, consultation with the MNRF may be required and a Licence to Collect Fish for Scientific Purposes may need to be obtained in advance of any potential impact.

4.5 Wildlife

The habitat in the Study Area is mostly disturbed and comprised of a high proportion of non-native vegetation. Mallards were observed in the pond, although the Site visits were conducted outside of the bird breeding period, so these could be migrants. A red-tailed hawk (*Buteo jamaicensis*) flew over the Site and black-capped chickadees (*Poecile atricapillus*) were using the trees and shrubs. Small nests were observed within some of the shrubs, but these were no longer active. The wetland vegetation around the SWM pond likely provide nesting habitat for a variety of wetland birds and other wildlife that are tolerant of high local disturbance. The SWM pond and adjacent wetlands are likely used by frogs and turtles, although no frogs or basking turtles were observed during any of the western chorus frog surveys.

4.6 Species at Risk

Information relating to the locations of species listed as Endangered and Threatened under the ESA is considered sensitive, and is therefore protected under the act. The specific information provided here is intended solely for the purpose of project planning and should be distributed only as necessary to project team constituents and regulatory agencies.

Under the ESA, there is protection afforded to both the species and their habitat, even when the habitat is not currently occupied. No SAR specific-surveys for provincially listed species were conducted at this point in the project, with the exception of plant species that could have been identified during the Site visits, if they were present. Further investigation of potential habitat available within the Study Area may be needed in order to determine the habitat occupancy of SAR, if there is any potential for impacts to those species or their habitat from scheduled activities.

Through the review of available databases described in Table 1, 20 SAR species were identified in the general area that includes the Study Area. In most cases, the record for these species is from a broader area which does not necessarily indicate that the species occurs within the Study Area. The habitat requirements of each species was compared to the habitat available within the Study Area to determine the likelihood that it would occur. The details of this assessment are provided in Appendix C.

The SAR list includes five species that were listed as Special Concern and are therefore not directly afforded protection under the ESA even if they were present in the Study Area. Of the fourteen species listed as Endangered or Threatened, three plant species were determined not to be present in the Study Area based on the Site visits and ten species were determined to have a low probability to occur within the Study Area. The Blanding's turtle (*Emydoidea blandingii*) was considered to have moderate probability to occur in the Study Area. Blanding's turtle could use the SWM ponds and adjacent wetlands, although this species was included only based on one record from 2011 in the general area that was included in the Ontario Herpetofaunal Atlas. No species-specific studies were conducted for this species in the appropriate timing window.

One species listed on the federal Species at Risk Act (SARA), namely the western chorus frog, was determined to have a high potential for occurrence within the Study Area, but was not detected during any of the surveys.

5. Summary

The Study Area is a mix of naturalized and disturbed habitat with invasive and pioneer vegetation species. Some wetland habitat is provided for use by wildlife. However, no frogs or turtles were observed during the Site visits. It is adjacent to a larger wetland complex that is unevaluated. The SWM ponds may be considered part of this wetland complex if an evaluation is completed under the Ontario Wetland Evaluation System (OWES). Permits for the alteration of the pond may be required from TRCA or the MNRF in the event that there is any predicted impact to these species or their habitat, including the wetland. Further investigation of potential habitat available within the Study Area may be required in order to determine the habitat occupancy of SAR, if there is any potential for impacts to those species or their habitat from scheduled activities.

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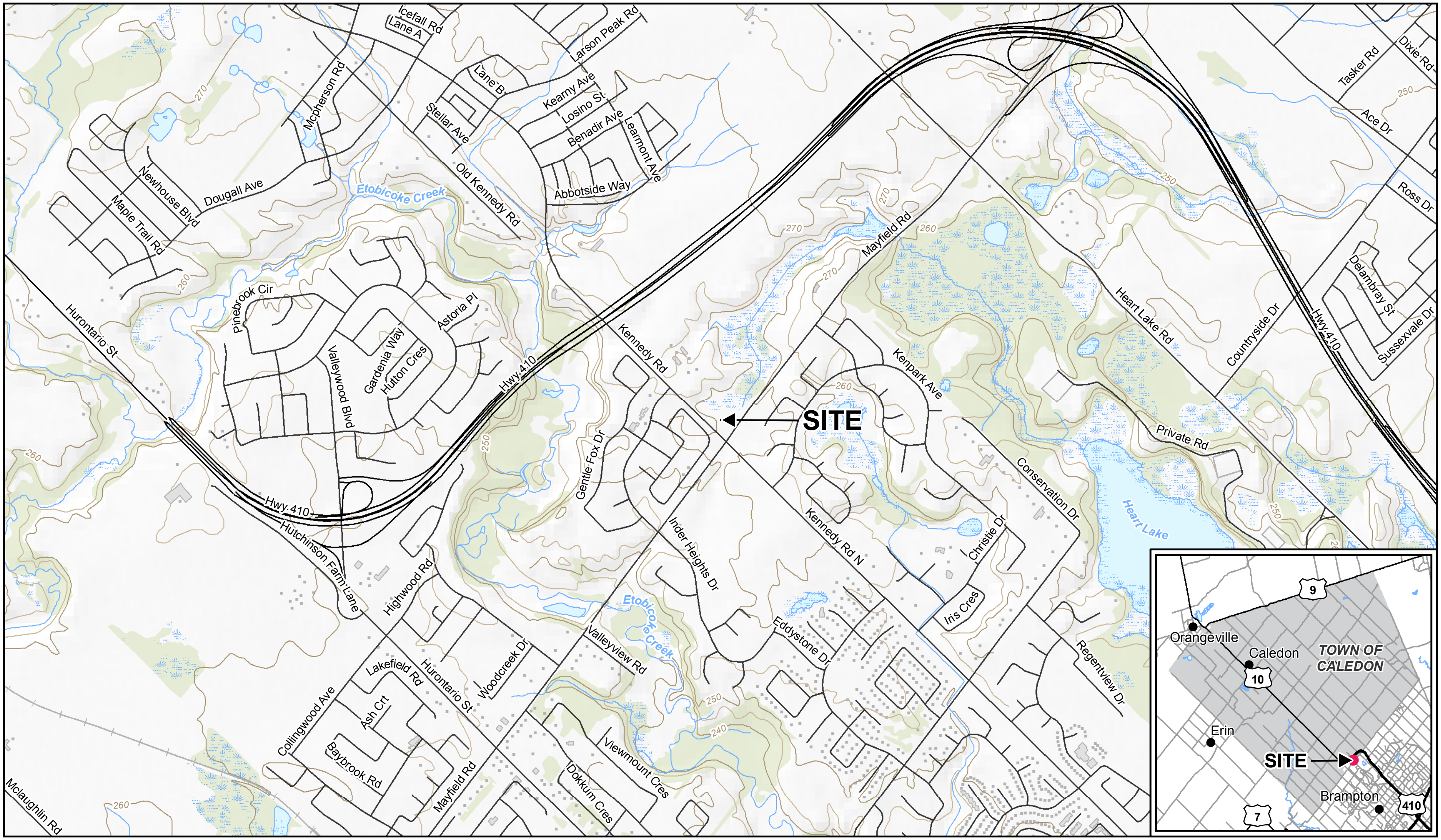

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Meters

Coordinate System:
NAD 1983 UTM Zone 17N

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GHD

REGIONAL MUNICIPALITY OF PEEL
KENNEDY SWM POND, TOWN OF CALEDON, ONTARIO
NATURAL ENVIRONMENT EXISTING CONDITIONS

SITE LOCATION MAP

11129100-100
Mar 20, 2017

FIGURE 1

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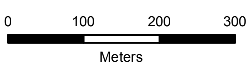

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REGIONAL MUNICIPALITY OF PEEL
KENNEDY SWM POND, TOWN OF CALEDON, ONTARIO
NATURAL ENVIRONMENT EXISTING CONDITIONS

11129100-100
Mar 20, 2017

SIGNIFICANT NATURAL FEATURES

FIGURE 2

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Coordinate System:
NAD 1983 UTM Zone 17N

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REGIONAL MUNICIPALITY OF PEEL
KENNEDY SWM POND, TOWN OF CALEDON, ONTARIO
NATURAL ENVIRONMENT EXISTING CONDITIONS

11129100-100
Mar 20, 2017

AQUATIC FEATURES AND WETLANDS

FIGURE 3

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Attachments

Attachment A
Photographic Log

Photo 1 - Kennedy Pond facing east

Photo 2 - Kennedy Pond facing west

Site Photographs

Attachment B
Vegetation and Wildlife Species Records

Attachment B

Incidental Wildlife and Vegetation Inventory
Kennedy Pond
Natural Environment Existing Conditions
Region of Peel

Common Name	Scientific Name
Birds	
Red-winged blackbird	*Agelauis phoeniceus*
Mallard	*Anas platyrhynchos*
Great blue heron	*Ardea herodias*
Canada goose	*Branta canadensis*
Red-tailed hawk	*Buteo jamaicensis*
Northern cardinal	*Cardinalis cardinalis*
Turkey vulture	*Cathartes aura*
Killdeer	*Charadrius vociferus*
Song sparrow	*Melospiza melodia*
Black-capped chickadee	*Poecile atricapillus*
Eastern pheobe	*Sayornis pheobe*
American robin	*Turdus migratorius*
Vegetation	
Norway maple	*Acer platanoides*
Staghorn sumac	*Rhus typhina*
Wild mustard sp.	*Cruciferae sp.*
Late goldenrod	*Solidago gigantea*
Common mullien	*Verbascum thapsus*
Willow	*Salix sp.*
Purple loosestrife	*Lythrum salicaria*
Red-osier dogwood	*Cornus sericea*
Eastern-white cedar	*Thuja occidentalis*
Garlic mustard	*Alliaria petiolata*
Field sow thistle	*Sonchus arvensis*
Wild Carrot	*Daucus carota*
Sweet cherry	*Prunus avium*
Cow vetch	*Vicia cracca*
Reed canary grass	*Phalaris arundinacea*
Coneflower	*Echinacea sp.*
Burdock	*Arctium sp.*
Hawthorn	*Crataegus*
Eastern cottonwood	*Populus deltoides*
Teasel	*Dipsacus fullonum*
Sweet white clover	*Melilotus albus*
Common yarrow	*Achillea millefolium*
Narrow-leaved cattail	*Typha angustifolia*

Attachment C
Species at Risk Screening Table

Attachment C

Species at Risk Screening
Kennedy Pond

Common Name	Scientific Name	Taxon	Source[1]	ESA Status[2]	Habitat Description	Likelihood to Occur on the Site[3]	Rationale for Likelihood
Barn Swallow	*Hirundo rustica*	Birds	MNRF, OBBA	Threatened	In Ontario barn swallow breeding habitat contains a suitable nesting structure, open areas for foraging, and a body of water that provides mud for nest construction (Lepage 2007, COSEWIC 2011). This species nests in human made structures including barns, buildings, sheds, bridges, and culverts (Lepage 2007, COSEWIC 2011). This species commonly nests in small colonies, occasionally reaching 50 pairs or more in number (Lepage 2007). Preferred foraging habitat includes grassy fields, pastures, agricultural cropland, lake and river shorelines, cleared rights-of-way, and wetlands. Mud nests are fastened to vertical walls or built on a ledge underneath an overhang. Suitable nests from previous years are reused (Brown and Brown 1999). In Ontario the barn swallow is widespread and common in southern Ontario south of the Canadian Shield and has a scattered distribution in the Southern Shield. It breeds in isolated pockets in northwestern Ontario especially in the vicinities of Thunder Bay and Lake of the Woods, and has a sporadic breeding distribution north to the Hudson Bay lowlands, largely absent from the boreal forest (Lepage 2007).	Low	Although Barn Swallows may feed over the wetlands, there are no suitable structures for nesting. This species was not observed during the Site visit.
Bank Swallow	*Riparia riparia*	Birds	MNRF, OBBA	Threatened	Bank swallows nest in burrows in natural and human-made settings where there are vertical faces in silt and sand deposits. Many nests are on banks of rivers and lakes, but they are also found in active sand and gravel pits or former ones where the banks remain suitable. The birds breed in colonies ranging from several to a few thousand pairs. The bank swallow migrates south for the winter, primarily to South America.	Low	Although Bank Swallows may feed over the wetlands, there are no suitable banks for nesting. This species was not observed during the Site visit.
Bobolink	*Dolichonyx orizivorus*	Birds	MNRF, OBBA	Threatened	In Ontario, the bobolink (Dolichonyx oryzivorus) breeds in grasslands or graminoid dominated hayfields with tall vegetation (Gabhauer 2007). Bobolinks prefer grassland habitat with a broad-leaf component and a substantial litter layer. They have low tolerance for presence of woody vegetation and are sensitive to extensive mowing. They are found in greater numbers in old fields where mowing and re-sowing are infrequent, preferably at intervals of several years (Martin & Gavin 1995). Their nest is woven from grasses and forbs. It is built on the ground, in dense vegetation, usually under the cover of one or more broad-leaved forbs (Martin & Gavin 1995).	Low	Grassland is present in the Site, but it is dominated by large-leaved vegetation and not a large enough grassland overall to be suitable for nesting of this species. This species was not observed during the Site visit.
Chimney Swift	*Chaetura pelagica*	Birds	OBBA	Threatened	Chimney swift breeding habitat is varied and includes urban, suburban, rural and wooded sites. They are most commonly associated with towns and cities with large concentrations of chimneys (COSEWIC 2007). Preferred nesting sites are dark, sheltered spots with a vertical surface to which the bird can grip. Unused chimneys are the primary nesting and roosting structure, but other anthropogenic structures and large diameter cavity trees are also used. Chimney swifts usually nests one pair to a chimney, and will roost in large colonies outside of the breeding season (COSEWIC 2007, Cink and Collins 2002).	Low	Although Chimney may feed over the wetlands, there are no suitable structures (chimneys) for nesting. This species was not observed during the Site visit.
Common Nighthawk	*Chordeiles minor*	Birds	OBBA	Special Concern	In Ontario, Common nighthawk habitat consists of opens habitats with little groundcover including: forested, rural-agricultural and urban environments (Sandilands 2007, COSEWIC 2007). It is found in rock barrens, alvars, sand barrens, bogs, fens, and in forest openings created by natural and anthropogenic disturbance (Sandilands 2007). In southern Ontario farmlands it has nested in grasslands, gravel pits, alvars, pastures and airports. In urban areas, Common nighthawks nest mainly on graveled rooftops (Sandilands 2007). Nest on the ground usually in the open. Urban nesting birds may prefer large roofs (Brigham et al. 2011). The Common nighthawk breeds throughout the entire province of Ontario from the Carolinian region to the Hudson's Bay Lowlands. South of the Southern Shield this species occurs most commonly in urban environments and is largely absent from areas of intensive agriculture (Sandilands 2007). Egg dates in Ontario have been reported between May 26th and August 13th (Peck and James 1983, Peck and James 1994).	Low	There are no suitable open gravel or rock areas or roofs for Common Nighthawk to nest. This species was not observed during the Site visit.
Eastern Meadowlark	*Sturnella magna*	Birds	MNRF, OBBA	Threatened	In Ontario, breeding habitat of eastern meadowlark is pastures, hayfields, meadows/old fields (Leckie 2007). Eastern meadowlarks prefer moderately tall grasslands with abundant litter cover, high grass proportion, and a forb component (Hull 2002). They prefer well drained sites or on slopes (Roseberry and Klimstra 1970). Sites with different cover layers are preferred (Hull 2002, Skinner 1975). The Eastern meadowlark builds a nest of woven grasses on the ground amongst dense vegetation. Most eggs are laid in late May or early June although the Eastern meadowlark may begin laying as early as the beginning of May (Leckie 2007).	Low	Grassland is present in the Site, but it is dominated by large-leaved vegetation and not a large enough grassland overall to be suitable for nesting of this species. This species was not observed during the Site visit.
Eastern Wood-pewee	*Contopus virens*	Birds	MNRF, OBBA	Special Concern	The eastern wood-pewee lives in the mid-canopy layer of forest clearings and edges of deciduous and mixed forests. It is most abundant in intermediate-age mature forest stands with little understory vegetation.	Low	There is no mature woodland within the Site. This species was not observed during the Site visit.
Wood Thrush	*Hylocichla mustelina*	Birds	MNRF, OBBA	Special Concern	The wood thrush lives in mature deciduous and mixed (conifer-deciduous) forests. They seek moist stands of trees with well-developed undergrowth and tall trees for singing perches. These birds prefer large forests, but will also use smaller stands of trees. They build their nests in living saplings, trees or shrubs, usually in sugar maple or American beech. The wood thrush flies south to Mexico and Central America for the winter.	Low	There are no mature deciduous stands of forest with moist soil and well-developed undergrowth that would be suitable for Wood Thrush. This species was not observed during the Site visit.
American ginseng	*Panax quinquefolius*	Vascular Plant	RVPO	Endangered	In Ontario, American ginseng is found in rich, moist, undisturbed and relatively mature deciduous woods often dominated by sugar maple (COSEWIC 2000a). It is also commonly found on south-facing slopes and in ravines. Ginseng grows under closed canopies in neutral, loamy soils.	None	There are no mature deciduous forest stands suitable for American ginseng within the Site. This species was not observed during the Site visit.
Butternut	*Juglans cinerea*	Vascular Plant	MNRF, NHIC, RVPO	Endangered	In Ontario, butternut is found along stream banks, in swamps, and in deciduous and mixed forests (Voss and Reznicek 2012). It is commonly associated with species including beech, maple, oak and hickory (Voss and Reznicek 2012). Butternut prefers moist, fertile, well-drained soils, but will also grow in rocky limestone soils (Farrar 1995). This species is shade intolerant (Farrar 1995).	None	Butternut can occur across a wide variety of soil types, but this species was not observed during the Site visit.

Attachment C

Species at Risk Screening
Kennedy Pond

Common Name	Scientific Name	Taxon	Source[1]	ESA Status[2]	Habitat Description	Likelihood to Occur on the Site[3]	Rationale for Likelihood
Dense Blazing Star	*Liatris spicata*	Vascular Plant	RVPO	Threatened	In Ontario, the dense blazing star is found mainly in moist tall-grass prairies, oak savannahs, wet meadows and along roadsides (COSEWIC 2010a; Voss and Reznicek 2012). It grows in moist to wet, sandy calcareous soils (WDNR 2013). This species requires full sun and so is found in open habitats (COSEWIC 2010a).	None	Although the open field within the Site could be suitable for this species, it was not observed during the Site visit.
Monarch	*Danaus plexippus*	Insects	OBA	Special Concern	Throughout their life cycle, Monarchs use three different types of habitat. Only the caterpillars feed on milkweed plants and are confined to meadows and open areas where milkweed grows. Adult butterflies can be found in more diverse habitats where they feed on nectar from a variety of wildflowers. Monarchs spend the winter in Oyamel Fir forests found in central Mexico.	Low	No Milkweed was found within the Site. This species was not observed during the Site visit.
Small-footed Myotis	*Myotis leibii*	Mammals	MNRF, BCI	Endangered	In the spring and summer, eastern small-footed bats will roost in a variety of habitats, including in or under rocks, in rock outcrops, in buildings, under bridges, or in caves and mines. This species does not roost in trees. These bats often change their roosting locations every day, but stay within a general area with multiple roost options. At night, they hunt for insects to eat, including beetles, mosquitos, moths, and flies. In the winter, these bats hibernate, most often in caves and abandoned mines, or other underground passages. They seem to choose colder and drier sites than similar bats and will return to the same spot each year.	Low	There are no rock features suitable for roosting and no underground features suitable for hibernation for this species.
Little Brown Myotis	*Myotis lucifugus*	Mammals	MNRF, BCI	Endangered	During the day this species roosts mostly in trees and buildings. They often select attics, abandoned buildings and barns for summer colonies where they can raise their young. Bats can squeeze through very tiny spaces (as small as six millimetres across) and this is how they access many roosting areas. Little brown bats hibernate from October or November to March or April, most often in caves or abandoned mines or similar underground spaces that are humid and remain above freezing.	Low	There are no mature trees or buildings suitable for summer roosting and no underground features suitable for hibernation for this species.
Northern Myotis	*Myotis septentrionalis*	Mammals	MNRF, BCI	Endangered	Northern long-eared bats normally roost in trees and rarely in buildings, choosing to roost under loose bark and in the cavities of trees. These bats hibernate from October or November to March or April, most often in caves, abandoned mines or similar underground spaces where they can find stable temperatures above freezing and high humidity.	Low	There are no mature trees or buildings suitable for summer roosting and no underground features suitable for hibernation for this species.
Tricolored Bat	*Perimyotis subflavus*	Mammals	MNRF, BCI	Endangered	During the summer, the Tri-colored Bat is found in a variety of forested habitats. It forms day roosts and maternity colonies in older forest and occasionally in barns or other structures. Although their specific roosting requirements in Ontario are very poorly known, they are most often roosting in leaf clumps, hanging mosses or squirrel nests. They forage over water and along streams in the forest. Tri-colored Bats eat flying insects and spiders gleaned from webs. These bats hibernate from October or November to March or April, most often in caves, abandoned mines or similar underground spaces where they can find stable temperatures above freezing and high humidity.	Low	There are no mature trees or buildings suitable for summer roosting and no underground features suitable for hibernation for this species.
Snapping Turtle	*Chelydra geographica*	Reptiles and Amphibians	MNRF, OHA	Special Concern	Snapping turtles spend most of their lives in water, but will often move over open terrestrial landscapes and roads. They prefer shallow waters so they can hide under the soft mud and leaf litter, with only their noses exposed to the surface to breathe. During the nesting season, from early to mid summer, females travel overland in search of a suitable nesting sites, usually gravelly or sandy areas along streams. Snapping turtles often take advantage of man-made structures for nest sites, including roads (especially gravel shoulders), dams and aggregate pits.	High	The ponds and wetlands in the Site are suitable for Snapping Turtles, although none were observed during the Site visit.
Blanding's Turtle	*Emydoidea blandingii*	Reptiles and Amphibians	OHA	Threatened	Blanding's Turtles live in shallow water, usually in large wetlands and shallow lakes with lots of water plants. It is not unusual, though, to find them hundreds of metres from the nearest water body, especially while they are searching for a mate or traveling to a nesting site. Blanding's Turtles hibernate in the mud at the bottom of permanent water bodies from late October until the end of April.	Moderate	The ponds and wetlands in the Site are suitable for Blanding's Turtles, although none were observed during the Site visit. However, there are very few historic records and little basking
Red-side Dace	*Clinostomus elongatus*	Fish	MNRF	Endangered	The Redside dace is found in pools and slow-moving areas of small streams and headwaters with a gravel bottom. They are generally found in areas with overhanging grasses and shrubs, and can leap up to 10 cm out of the water to catch insects. During spawning, they can be found in shallow parts of streams, which are also popular spawning areas for other minnow species.	Low	Aquatic habitat in the pond is not suitable for this species.
Western Chorus Frog	*Pseudacris triseriata*	Reptiles and Amphibians	OHA	Not Listed*	The Western Chorus Frog occupies a variety of lowland habitats with an open or discontinuous canopy, where slight depressions in topography allows the formation of wetlands (e.g.., marshes, swamps, ponds) that generally dry out in summer. The vegetation in those habitats is mainly herbaceous and partly submerged trees. The home range of an individual must provide for the specific needs of all life cycles (breeding, foraging, movement and hibernation).	High	The ponds and wetlands in the Site are suitable for Western Chorus Frogs, although none were observed during the Site visit.

Notes:

1 Species identified through a request to the Ontario Ministry of Natural Resources and Forestry (MNRF), Obtained from the Natural Heritage Information Centre (NHIC), the local Conservation Authority (CA), the Rare Vascular Plants of Ontario (RVPO), the Ontario Herpetofaunal Atlas (OHA), the Atlas of the Breeding Birds of Ontario (OBBA), the rare fish and mussel maps from the Department of Fisheries and Oceans (DFO) or the Ontario Butterfly Atlas (OBA).
2 Status of the species on the Species at Risk in Ontario list, and protected under the provincial *Endangered Species Act.*
3 Probability to occur is based on the reliability of the historic record, suitability of the habitat on site and classified as "None" for species where a sufficient survey confirmed absence, and "confirmed" if a survey identified the species on habitat.
* Species is not listed on the *Endangered Species Act* , but is listed on the federal *Species at Risk Act.*

Appendix E
Stormwater Management Operations and Maintenance Manual

Stormwater Management Operations and Maintenance Manual

Kennedy Stormwater Management Wetland

Town of Caledon

Region of Peel

GHD | 65 Sunray Street Whitby Ontario L1N 8Y3 Canada

11129100 |March 2017

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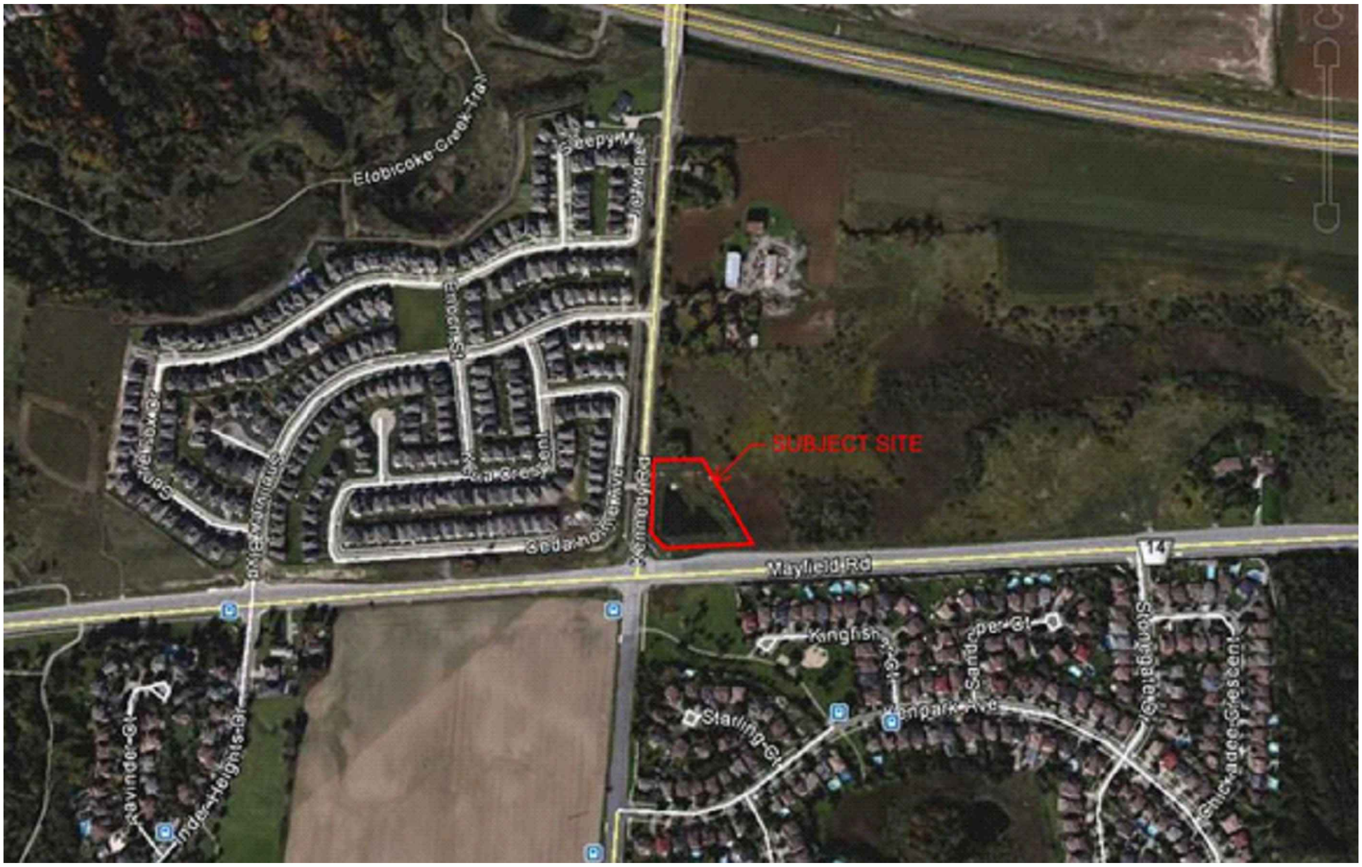
Drawings

1. Introduction

This Operations and Maintenance Manual has been prepared for the Region of Peel to provide an outline of the maintenance responsibilities, inspection procedures and associated estimated costs for the Kennedy Stormwater Management Facility, in accordance with the Ministry of the Environment Stormwater Management Planning and Design Manual (SWMP Manual), March 2003.

The existing SWM facility is located within the Etobicoke Creek watershed, adjacent to the intersection of Kennedy Road and Mayfield Road, in the Town of Caledon, Regional Municipality of Peel. The SWM facility services 9.76 hectare (ha) of existing road allowance. **Figure 1**, Key Plan, indicates the location of the existing facility and the contributing drainage area.



REGION OF PEEL
KENNEDY SWMF RETROFIT
CITY OF BRAMPTON
SITE LOCATION PLAN

Job Number	111-29100
Revision	A
Date	MAR.2017

Figure 01

65 Sunray Street, Whitby Ontario L1N 8Y3 **T** 1 905 686 6402 **F** 1 905 432 7877 **E** ytomail@ghd.com **W** www.ghd.com

Plot Date: 14 March 2017 - 9:54 AM Plotted by: Scott Sexton Cad File No: G:\111\11129100\CADD\Drawings\Water Resources\11129100 - Figure 1.dwg

2. Stormwater Management Facility

Full details of the SWM facility are described in the report entitled Kennedy Pond Stormwater Management Facility Retrofit, March 2017. Refer to **Drawing SWM-201** (rear pocket) for the detailed design of the facility. A brief summary of the facility design is as follows:

- Drainage from 9.76 ha of existing road allowance is directed to the SWM facility located adjacent to a tributary of Etobicoke Creek.
- A permanent pool volume of approximately 880 m^3 for quality control at a water elevation of 255.55m (geodetic).
- The erosion portion of the pond (extended detention) will have a depth of 0.60 m corresponding to a 25 mm water surface elevation of 256.15 m.
- An outlet control manhole containing a concrete wall with a 100mm diameter orifice at an invert elevation of 255.55m, will provide the extended detention storage for a detention time of approximately 55 hours. An overflow control weir at an elevation of 256.15m will control larger storm events.
- A 3.0m wide overflow spillway is located along the northeast side of the facility at an elevation of 256.30m, to control peak flows for the 5 through 100 year storm events to pre-development levels.
- A SWM Shield quality control structure located at the pond inlet to capture a significant portion of incoming sediment

3. Operations

3.1 Siltation Control

3.1.1 Upon Initial Completion of Facility Retrofit Works

Upon initial completion of the facility retrofit works, the as-constructed permanent pool volume will be confirmed as per the approved design drawing (**SWM-201**). If required, the pond will be re-excavated to obtain the required storage volume. Cleanout procedures will be in accordance with Section 5.0. Facility landscaping will be rehabilitated with compensatory plantings to account for the introduction of the new maintenance access path.

3.1.2 Continued Facility Operation by the Region

All inspection and maintenance requirements are detailed in Sections 4.0 and 5.0.

4. Inspection after Municipal Assumption

4.1 Frequency of Inspection

- After every significant rainfall (>10 mm) for the first two years of operation.
- Minimum of four visits per year after the first two years of operation (winter, spring, summer and fall).
- After the first 2 years, annual inspection of SWM Shield product for monitoring of sediment accumulation levels.

4.2 Inspection Checklist

An inspection checklist is located in **Appendix A**. This checklist can be completed following each site visit. The Region should keep a record of the completed checklists.

5. Maintenance Procedures

5.1 Grass Cutting

Grass cutting is not recommended for the pond in order to maintain a “natural” environment and increased water quality benefits. It is recommended that pond facility banks be cut to a height of 10cm every third year and the following practices should be considered:

- Minimize the frequency of cutting;
- Do not cut the grass up to the edge of the facility to maintain shading and nutrient uptake; and
- Do not blow grass clippings into the facility to minimize the organic loading in the pond.

5.2 Weed Control

Weed control of invasive alien species such as Dog Strangling Vines, European Buckthorn, Norway Maple, Garlic Mustard, etc., is recommended to be implemented on a bi-annual basis and the following item should also be considered:

- Prohibit the use of herbicides and insecticides due to the potential water quality concerns associated with downstream uses;

5.3 Plantings

Any replacement plantings required due to disturbance or die-out (upland, shoreline fringe or aquatic) are to be replaced in accordance with the original Landscape Plans or as otherwise deemed appropriate by the Region. Native species should be used for all plantings.

5.4 Litter and Debris Removal

Accumulated litter and debris within the facility can be removed by hand during the regular inspection periods.

5.5 Sediment Removal

5.5.1 SWM Shield Removals

The SWM Shield product has been design as a means to capture sediment as it enters the SWM Facility. As the product is new and historical information unavailable, the timeline for removals is unknown at this time. It is anticipated that the SWM Shield will capture approximately 50% of the incoming sediment loading, resulting in the product’s storage capacity reaching 50% after 3 years. Due to the unknown performance of the new product, it is recommended the sediment accumulation be reviewed two times per year the first 2 years, and annual thereafter. Based on the sediment accumulation, a more accurate loading rate can be determine and better estimate of cleanout frequency determined.

The SWM Shield has been design for sediment to be removed via vac-truck. The SWM Shield has been designed to stay separate from the permanent pool; therefore the drawdown of the permanent pool is not required to provide sediment removal services. It is recommended that excavated sediment be placed immediately into dump trucks for disposal. It can be noted that a sediment drying area is not always required, as the contractors which specialize in this work prefer to remove and haul away sediment in one operation to avoid double handling of materials. This method has proven to be more time and cost efficient.

Before removal, sediments are to be tested in accordance with MOE sediment disposal guidelines (most private laboratories are familiar with the guidelines) to ensure that sediment is handled and disposed of in an appropriate manner.

5.5.2 Forebay/Main Cell Sediment Removal Frequency

In accordance with MOE guidelines, the accumulated sediments within the SWM facility should be excavated upon a 5% decrease in total suspended solids (TSS) removal efficiency. Based on the enhanced protection level provided (80% TSS removal), cleanout will be required every 15 years (refer to **Appendix B** for calculations). At that time, MOE loading guidelines estimate that approximately 142 m^3 of sediment will have accumulated in the pond. The introduction of the SWM Shield product is meant to provide a means of reducing the sediment accumulation within the SWM facility. As such, the facility will not receive the above noted sediment loading anticipated for a typical end-of-pipe treatment method. It is recommended that a bathometric survey be provided at the 10 year period to determine the sediment accumulation. A review will be required to analyse the accumulation rate, and whether the permanent pool has adequate capacity to continue to provide the required quality controls in conformance with MOECC guidelines. Based on the sediment accumulation at that time, there will be a better understanding of the performance of the SWM Shield in conjunction with the SWM facility, and the maintenance schedule can be adjusted accordingly.

5.5.3 Method of Removal

To initiate the sediment removal process, several items need to be completed prior to commencement of works. A bathymetric survey will be required to estimate the volume to be removed. Engineering reports and plans, such as a Sediment Control Plan, may require completion to ensure that maintenance activities do not adversely affect the downstream watercourse. This process may also require communication and coordination with the Conservation Authority as regards servicing requirements and permits.

To remove the sediment, the permanent pool will be required to be pumped out. The bathometric survey will determine if both the forebay and main cell require excavation/sediment removal. A temporary bulk head can be placed in MH2 and water pumped to this location. The majority of this can be completed within the control manhole to minimize sediment disturbance

Once the facility is drained, the accumulated sediments can be excavated by backhoe or vactruck from the forebay area. The form of excavation should be given consideration based on the composition of the sediment within the forebay. Best efforts should be made to minimize disturbance to the structural base materials of the forebay(rip-rap, etc.). A temporary sediment drying area is not feasible due to the limited land available and proximity to the wetland. It is therefore recommended that the excavated sediment be placed immediately into trucks for disposal to minimize disturbance to existing aquatic and local vegetation.

5.5.4 Sediment Disposal

It is recommended that excavated sediment be placed immediately into dump trucks for disposal. This would assist in minimizing the disturbance of existing aquatic and local vegetation. It can be noted that a sediment drying area is not always required, as the contractors which specialize in this work prefer to remove and haul away sediment in one operation to avoid double handling of materials. This method has proven to be more time and cost efficient.

Before removal, sediments are to be tested in accordance with MOE sediment disposal guidelines (most private laboratories are familiar with the guidelines) to ensure that sediment is handled and disposed of in an appropriate manner.

6. Maintenance Costs

Based on **Table 1** below, the anticipated average annual maintenance cost for the pond will be approximately $19,515 based on 2017 dollars.

Table 1 Unit Costs for Operations and Maintenance

Type of Maintenance	Interval (# / yr)	Amount	Unit	Price / Unit (2016)	Total Cost
Litter/Debris Removal	1.0	0.53	ha	$1,200	$636
Vegetation Maintenance (Aquatic/Shoreline Fringe)	1.0	0.53	ha	$850	$450
Vegetation Maintenance (Upland/Flood Fringe)	1.0	0.53	ha	$1120	$594
SWM Shield Sediment Removal and Disposal(Off-Site Landfill)	0.25	40.5	m^3	$100	$1,620
Sediment Removal and Disposal[2] (Off-Site Landfill)	0.05	96	m^3	$220	$1,056
Sediment Testing [2] (Lab Tests on Quality)	0.1	1	each	$600	$60
Bathymetric Survey, Engineering Reports and Permits	0.1	1	each	$12,000	$1,200
Inspection (Inlet/Outlet, etc.)	1.0	1	-	$170	$170
				Total:	**$5,786**

[1] Source: Table 7.5 MOE, SWM Planning and Design Manual, March 2003.

[2] Sediment removal frequency determined to be once every 11 years, however maintenance is recommended after is typically done every10 years. Due to SWM Shield, pond excavation requirements are estimated to extend to 20 years. Costs are based on maintenance every 10 years.

7. Safety

7.1 Vegetation

The original SWM Pond Landscape Plan utilizes strategic planting location and species to discourage direct access to the pond wherever possible. Any revegetation should be completed in accordance with the original plans where plantings do not interfere with the new maintenance path.

7.2 Signage

Safety signage should be confirmed as installed per **Drawing SWM-201 and SWM -202** to notify the public of the potential safety concerns associated with the permanent pool within the pond and flooding that may occur during rainfall events.

7.3 Infrastructure

Headwall has been constructed as per OPSD 804.030 with grates as per OPSD 804.05. Pedestrian guard rails are proposed in areas where standard side slopes were not possible. Details are included on **Drawing SWM-202**.

Appendices

Appendix A
Inspection Checklist

APPENDIX A

Pond Inspection/Monitoring Checklist

Date: ___________________________________

Engineering Item		Maintenance Required (Y/N)	Comments
1.	Outlet Blockage (Is the pond level higher than the normal permanent pool level 24 hours after a rainfall?)		
2.	Inlet Blockage (Is the pond level lower than the permanent pool elevation?)		
3.	Pollutants (Hydrocarbon (oil), algae etc.)		
4.	Sediment Depth (Has minimum depth of ____m been achieved at low point?)		
5.	Trash Build-up		
6.	Outlet (Signs of erosion)		
7.	Berm Stability and Shoreline Erosion		
8.	Inlet Structure		
9.	Outlet Structure		
10.	Maintenance Access		
11.	Fence, Locks, Gate		
12.	Overland Flow Inlet		
13.	Water Level ___m Elev. (Is water elevated above permanent pool elevation?)		
14.	High Water Marks __m Elev.		
Landscaping Item		**Maintenance Required (Y/N)**	**Comments**
15.	Aquatic Vegetation		
16.	Shoreline Vegetation		
17.	Upland Vegetation		
18.	Invasive Species Present?		
19.	Additional Comments		

Appendix B
Sediment Removal Frequency

Project Name:	Region of Peel - Kennedy Pond
Project No.:	11129100
Description:	Sediment Removal Frequency

Drainage Area	9.76	ha
Imperviousness	45%	
SWMP Type	WL	(Infiltration (I), Wetlands (WL), Hybrid (H), Wet Pond (WP))
Protection Level	1	
Total Suspended Solids Removal	80%	
Reduction in Efficiency to Initiate	5%	
Starting Storage Volume	52	m^3/ha
Permanent Pool Volume	508	m^3

Table 6.3: Annual Sediment Loading
(MOE SWM Planning and Design Manual, March 2003)

Imperviousness	Loading (kg/ha)	Wet Density (kg/m^3)	Loading (m^3/ha)
35%	770	1230	0.63
55%	2300	1230	1.87
70%	3495	1230	2.84
85%	4680	1230	3.80

Annual Loading/ha	1.3	m^3/ha/yr
Annual Loading	12.2	m^3/yr

Year	Starting Storage Volume m^3/ha	Sediment Removal Efficiency %	Amount of Sediment Removed m^3	Starting Permanent Pool Volume m^3	End of Year Permanent Pool Volume m^3	End of Year Storage Volume m^3/ha	Cumulative Sediment Removed m^3
1	52	80.0%	9.760	507.8	498.1	51.0	9.8
2	51.0	79.6%	9.715	498.1	488.3	50.0	19.5
3	50.0	79.3%	9.669	488.3	478.7	49.0	29.1
4	49.0	78.9%	9.624	478.7	469.0	48.1	38.8
5	48.1	78.5%	9.579	469.0	459.5	47.1	48.3
6	47.1	78.2%	9.535	459.5	449.9	46.1	57.9
7	46.1	77.8%	9.490	449.9	440.4	45.1	67.4
8	45.1	77.4%	9.446	440.4	431.0	44.2	76.8
9	44.2	77.1%	9.402	431.0	421.6	43.2	86.2
10	43.2	76.7%	9.358	421.6	412.2	42.2	95.6
12	41.3	76.0%	9.271	402.9	393.6	40.3	114.2
13	40.3	75.6%	9.228	393.6	384.4	39.4	123.4
14	39.4	75.3%	9.185	384.4	375.2	38.4	132.6
15	38.4	74.9%	9.142	375.2	366.1	37.5	141.7
16	37.5	74.6%	9.100	366.1	357.0	36.6	150.8
17	36.6	74.2%	9.057	357.0	347.9	35.6	159.9
18	35.6	73.9%	9.015	347.9	338.9	34.7	168.9
19	34.7	73.5%	8.973	338.9	329.9	33.8	177.9
20	33.8	73.2%	8.931	329.9	321.0	32.9	186.8
21	32.9	72.9%	8.890	321.0	312.1	32.0	195.7
22	32.0	72.5%	8.848	312.1	303.3	31.1	204.5
23	31.1	72.2%	8.807	303.3	294.5	30.2	213.3
24	30.2	71.9%	8.766	294.5	285.7	29.3	222.1
25	29.3	71.5%	8.725	285.7	277.0	28.4	230.8
26	28.4	71.2%	8.684	277.0	268.3	27.5	239.5
27	27.5	70.9%	8.644	268.3	259.7	26.6	248.2
28	26.6	70.5%	8.604	259.7	251.0	25.7	256.8
29	25.7	70.2%	8.564	251.0	242.5	24.8	265.3
30	24.8	69.9%	8.524	242.5	234.0	24.0	273.9
50	8.1	63.6%	7.764	79.4	71.6	7.3	436.2
53	5.8	62.8%	7.656	56.2	48.5	5.0	459.3
54	5.0	62.5%	7.620	48.5	40.9	4.2	466.9
55	4.2	62.2%	7.584	40.9	33.3	3.4	474.5
56	3.4	61.9%	7.549	33.3	25.8	2.6	482.1
57	2.6	61.6%	7.514	25.8	18.2	1.9	489.6

Cleanout when Sediment Removal Efficiency drops to:	75%	
Sediment Removal Frequency	**15**	**Years**
Total Sediment Accumulated	142	m^3
Recommended Cleanout	10	Years
	96	m^3

Appendix C
CB Shield Inc. – Predicted Performance of SWM Shield Units

CB SHIELD INC.

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(T) 519-212-9161
info@cbshield.com

File: GHD-101

March 7, 2017

GHD Whitby
65 Sunray Street
Whitby ON L1N 8Y3

Attention: **Jamie Iantomasi, P. Eng.**
Water Resource Engineer

Reference: **Region of Peel SWM Facilities Retrofit, GHD # 11129100**
Predicted Performance of SWM Shield Units

Dear Jamie:

As requested, we are providing you with sizing and predicted performance information for your consideration in implementing SWM Shield™ stormwater devices at existing SWM facility retrofits at Heart Lake Road/Mayfield Road and Kennedy Road/Mayfield Road in the City of Brampton, Region of Peel. We understand the two SWM facilities, which are owned and operated by the Region of Peel, are undergoing retrofits that will be designed by GHD.

The sizing of these devices, as you are aware, is based on ETV testing originally completed for the CB Shield™. Our scaling of the much smaller CB Shield device up to the SWM Shield size will be outlined in this letter, and will include an important statement regarding the potential limitations of that scaling. We are quite aware that the scaling involved will require confirmation through testing, and therefore we cannot support claims of performance with the same certainty as our smaller ETV verified CB Shield device. However, we are confident that theoretical calculations will provide good general expectations of performance for the two proposed units.

Site Parameters

We have based our review on the catchment parameters provided for the Heart Lake Road/Mayfield and Kennedy Road/Mayfield Road SWM facilities as follows:

Heart Lake Facility: Area = 10.29 ha
Imperviousness = 45%

Kennedy Facility: Area = 9.02 ha
Imperviousness = 58%

Initial Sizing of the SWM Shields

SWM Shield sizing is based on treatment principles determined through ETV testing and verification completed for the CB Shield. Accordingly, a first approximation at sizing any given SWM Shield relates back to the average number of catch basins that would be found in a similar catchment area. The approximate the number of catch basins in a residential catchment can be roughly estimated using a ratio of 5 CB's per hectare, which is typical for residential areas. This allows a quick determination of treatment surface area as follows:

- SWM Shield Area (m^2) = Area of CB Shield grate (m^2) X 5 CB's/ha X Total Site Area (ha)
- SWM Shield Area = 0.36 m^2/CB X 5 CB's/ha X Total Site Area (ha)

In the case of the Heart Lake Facility the approximate the number of catch basins that would typically be in a catchment area of this size can be determined as:

- 10.29 ha X 5 CB's/ha = 51.5 CB's

With this translating to a cumulative treatment area approximation of:

- Heart Lake SWM Shield treatment area (m^2) = 51.5 CB Shields X 0.36 m^2/CB Shield = **18.5 m^2**

This initial approximation allows a corresponding number of standard precast lengths to be determined that would provide the required surface area. Each standard length of SWM Shield grate is typically:

- 3.0 m X 2.5 m = 7.5 m^2 per section, with this calculation corresponding to the standard concrete box section used most often - approximately 10 feet by 8 feet.

Calculating the approximate number of box sections required for the Heart Lake SWM Shield:

- 18.5 m^2 / 7.5 m^2/box section = 2.5 box sections

Given the economies of working with whole box sections and to also ensure some additional conservativeness in design, rounding up to 3 whole box sections is warranted.

Similar calculations for the Kennedy Facility yields the same 3 whole sections as its preliminary size.

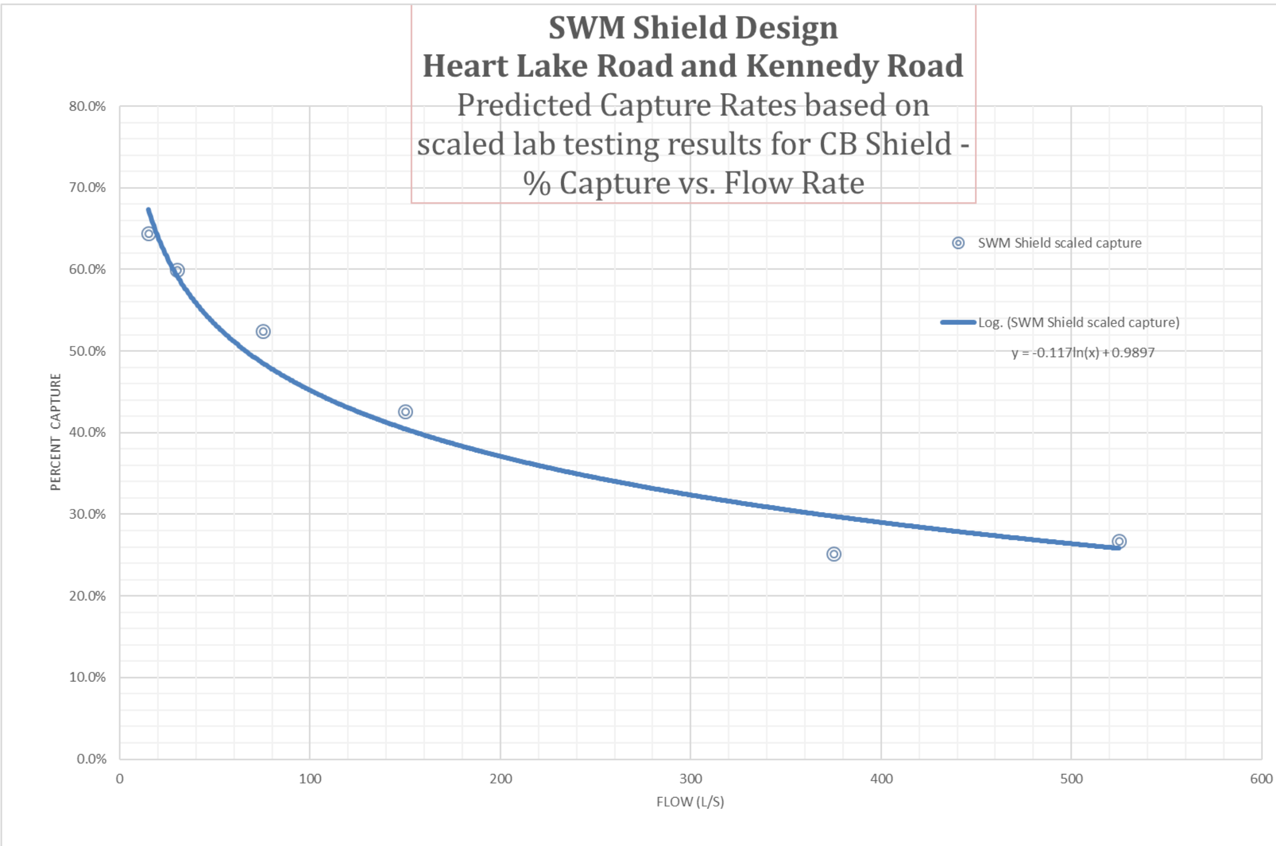
The total surface area associated with each SWM Shield is then calculated as: 3 X 7.5 = **22.5 m^2**

Detailed Sizing and Scaling Discussion

SWM shield predicted performance is based on a scaled version of the CB Shield's removal performance testing results as contained in CB Shield's ETV Verified Performance Claim. The scaling of performance data is made based on total treatment area of surface loading, which in this case is the area of grate. The grate is in contact with permanent water in the sump below during flow events, with sediment removed from the flow stream by gravity settling. Settled particles then proceed further through the grate and into the sump where it is stored until the unit is maintained.

The SWM Shield is also expected to mimic performance of the CB Shield with respect to its anti-scour properties. The similar grate type design combined with a greater depth of sump allows for an expectation that scour will be limited from the SWM Shield even during extreme flow events.

The following chart outlines a flow vs. capture ratio in the proposed SWM Shield model that will be implemented at both of the sites:



Data points in the capture curve above are identical to those contained in the ETV Verified claim for CB Shield except that the flow values have been increased by a factor of 62.5, which is the exact factor of increase in the surface area of the proposed SWM Shield as compared with a standard CB Shield.

It should be noted that the proposed SWM Shield has a sump depth that is only 4 times deeper than that of the standard CB Shield (i.e. 2.4 m vs. 0.6 m depth). However, this difference in depth is not predicted to affect performance other than affecting the cycle of maintenance which is outlined later in this brief.

Predicted Performance

Each of the catchment areas was modelled in PCSWMM, using long term continuous rainfall data from the Bloor Street meteorological station. From this, various flow rates were determined corresponding to their average annual percentage of total volume of flow. This flow was then matched against the corresponding removal rate for the SWM Shield, as determined through scaling from a CB Shield ETV Verified testing data.

If required, the simple approach outlined above can be supplemented through more advanced water quality modelling (within PCSWMM) of the catchments and the SWM Shield treatment devices. Additional modeling would target better description of sediment transport characteristics from the catchments and the associated variation with flows.

Our initial analyses for each of the two SWM Shields indicate similar predicted long term capture of sediment in each unit, due to their similar catchment characteristics. Each unit's predicted long term capture is outlined in the charts below:

Heart Lake Road SWM Shield Predicted Performance			
Flow (L/s)	Average Annual % of Flow	% Capture per Scaled Lab Results	Cumulative Annual Capture
5	21	64%	14%
15	45	64%	15%
25	60	61%	9%
50	77	53%	9%
100	88	45%	5%
150	92	40%	2%
200	94	37%	1%
		TOTAL:	**55%**

Kennedy Road SWM Shield Predicted Performance			
Flow (L/s)	Average Annual % of Flow	% Capture per Scaled Lab Results	Cumulative Annual Capture
5	20	64%	13%
15	43	64%	15%
25	57	61%	9%
50	74	53%	9%
100	87	45%	6%
150	92	40%	2%
200	94	37%	1%
		TOTAL:	**54%**

Maintenance Cycle

Frequency of maintenance will be a function of total stormwater volume directed to each SWM Shield, the loading within the stormwater, and the capture rate of the SWM Shield.

Total volume of stormwater and loading annually directed to each device (on average) is calculated given:

- Approximately 792 mm of precipitation for City of Toronto
- For imperviousness values of 45% and 58%, average precipitation to runoff is estimated at 50% and 60% respectively.
- Stormwater is assumed to contain 125 mg/L of total suspended solids.
- Sediment from stormwater is assumed to have a density of 1.23 kg/L (per MOECC)

Volume of Sediment Captured Calculations:

Heart Lake Road catchment:

- Sediment loading (kg/yr) = 10.29 ha X 792 mm X 50% runoff X 125 mg/L
- Sediment loading (kg/yr) = 5,094 kg/year
- Sediment capture = 5,094 kg/year X 55% capture rate = 2802 kg/year
- Sediment volume captured = 2802 kg/year / 1.23 kg/L = 2.3 m^3/year

Kennedy Road catchment:

- Sediment loading (kg/yr) = 9.02 ha X 792 mm X 60% runoff X 125 mg/L
- Sediment loading (kg/yr) = 5,358 kg/year
- Sediment capture = 5,358 kg/year X 54% capture rate = 2893 kg/year
- Sediment volume = 2893 kg/year / 1.23 kg/L = 2.4 m^3/year

A quick comparison with the MOECC 2003 Guideline document (Table 6.3 reproduced below) indicates a higher predicted loading rate using Table 6.3:

Table 6.3: Annual Sediment Loadings

Catchment Imperviousness	Annual Loading (kg/ha)	Wet Density (kg/m^3)	Annual Loading (m^3/ha)
35%	770	1,230	0.6
55%	2,300	1,230	1.9
70%	3,495	1,230	2.8
85%	4,680	1,230	3.8

SWM Planning & Design Manual - 6-13 - *Operation, Maintenance and Monitoring*

Heart Lake Road catchment using MOECC:

- Annual sediment loading (kg/yr) = 1,535 kg/ha X 10.29 ha = 15,795 kg/year
- Annual sediment captured = 15,795 kg/yr X 55% capture rate = 8,687 kg/year

- Sediment volume captured = 8687 kg/yr / 1.23 kg/L = 7.0 m^3/year

Kennedy Road catchment using MOECC:

- Annual sediment loading (kg/yr) = 2,539 kg/ha X 9.02 ha = 22,902 kg/year
- Annual sediment captured = 22,902 kg/yr X 54% capture rate = 12,367 kg/year
- Sediment volume captured = 12,367 kg/yr / 1.23 kg/L = 10.0 m^3/year

Given the proposed SWM Shield configuration for both locations has a sediment holding capacity (prior to maintenance requirement) of approximately 40 m^3, corresponding to a depth of 1.8 m of the total available sump of 2.4 m. Accordingly, each facility should be expected to be maintained as follows:

- Heart Lake Road Facility maintained every 40m^3 / 7 m^3/year = 5.7 years
- Kennedy Road Facility maintained every 40m^3 / 10 m^3/year = 4 years

Actual accumulation of sediment should be determined through an annual maintenance check. In them interim, we would recommend consideration of the higher MOECC Table 6.3 based loadings.

Closure

Please note that we would be pleased to assist with pursuing approvals you may require from the Ontario Ministry of Environment and Climate Change (MOECC), Toronto Region Conservation Authority (TRCA) and others as may be required.

In summary, we are able to predict at least a 50% long term average removal of sediment from runoff in both the Heart Lake Road and Kennedy Road SWM facilities given installation of suitably sized SWM Shield units. Maintenance cycles for the SWM Shield will be approximately 4 to 6 years.

In closing, we would be happy to provide any further details required. Please feel free to contact me at your convenience.

Thank you.

Yours very truly,
CB Shield Inc.

Stephen Braun, P.Eng.
Engineering Director
stephen.braun@cbshield.com

SWM Shield Storm Water Quality System
DESIGN CRITERIA AND SPECIFICATIONS

Description
Water quality system located in a pond at the inlet which may replace sediment fore-bay. Sediment enters the box culvert tank through slotted openings in the top slab.

General Design

- SWM Shield systems are designed to capture sediment before it can enter the pond. At least 90% of all runoff will pass over the entire slotted roof slab before entering the pond. At least 50% of the total suspended solids will be captured by the SWM Shield in a standard design (based on ETV particle size distribution)
- Sediment removal will be project specific and the design performance will be supplied by CB Shield staff.
- Systems are precast concrete box culvert as per OPSS 1821.
- SWM Shield is not designed for traffic loading due to a large number of slotted openings in the top slab. It has walls on each side of the top slab to contain the water and keep vehicles off. If safety concerns exist, a grate may be required to cover the entire top slab.
- SWM Shield is installed on a minimum of 6 inches of ¾ inch aggregate stone with a minimum soil bearing capacity of 2,000 psf. This may vary depending on the pond bed stability and will be left to the engineer's discretion.
- All joints of the SWM Shield system **must be water tight** so water does not leak in/out of the system during cleaning or normal operation. It is therefore the contractor's responsibility to add extra waterproofing in addition to what is supplied by the SWM Shield manufacturer. There are a number of products on the market to achieve this.
- The invert of the pipe out letting into the pond must be equal to or higher than the top of the SWM Shield system. The SWM Shield is best designed when the top slab is 350mm higher than the pond level. If that is not possible another option in the end of system design is available.
- Upon request during the design process an oil baffle or sock may be included to treat dry weather spills.
- Upon request and prior to project initiation, photo documentation of the system installation can be supplied.

INSPECTION AND MAINTENANCE REQUIREMENTS

- The system is designed to be in the pond with an adjacent access road. The outside wall on top of the system will be 900mm high. The inside wall which is open to the pond is 600mm high. This is to allow large storms to spill over the inside wall directly into the pond when necessary.
- The units will be accessible for inspection and cleaning through a manhole frame and cover every 2.5m. Units should be cleaned when the average depth of sediment inside the system is 1800mm. (This for the standard 3000 x 2400mm size) We recommend yearly inspections until a pattern for sediment loading is established.
- Systems can be cleaned by using a vacuum truck. A pressure water hose forcing all sediment to one end of the system may also be helpful. The units may be entered by persons trained in confined space entry.
- Water can be decanted from the SWM Shield tank directly into the pond, leaving only the sediment for the vacuum truck to remove and dispose of.

GHD

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Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
	J. Iantomasi	K. Edgington		K. Edgington		Mar 13/17
1	J Iantomasi	K. Edgington		K. Edgington		May 19/17

www.ghd.com

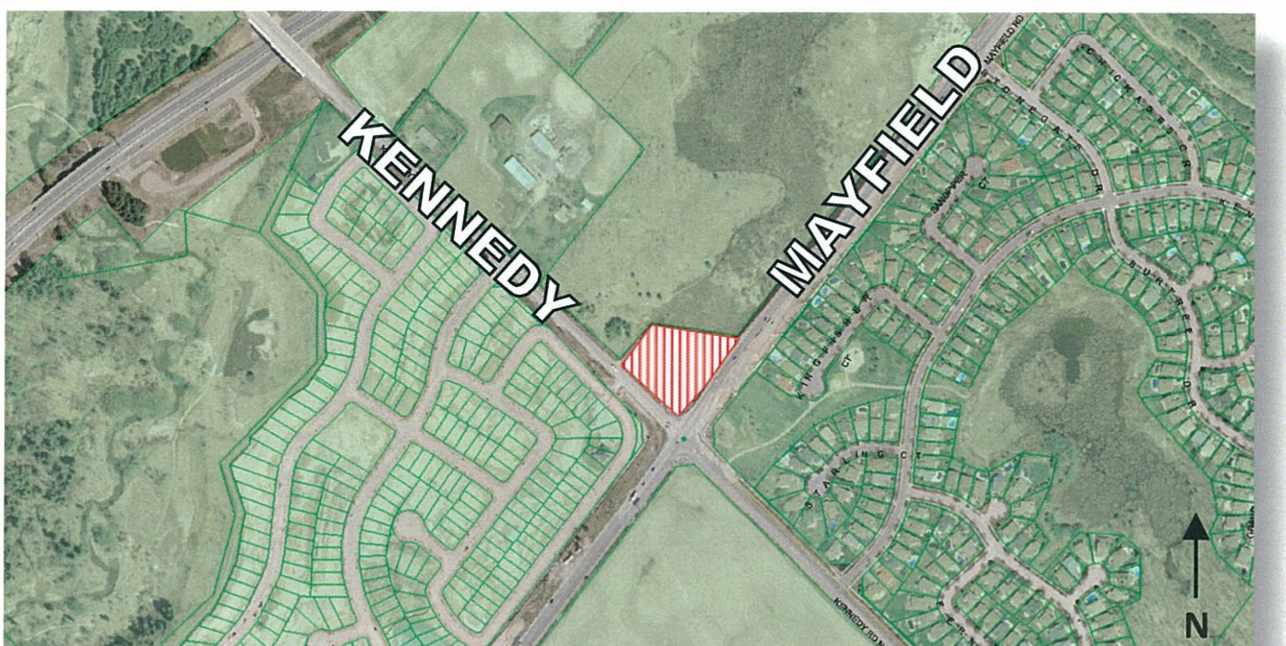
Appendix F
Original Design and Background Information

REGIONAL STORMWATER MANAGEMENT
FACILITY FILES

Region of Peel
Working for you

SWM POND 1

KENNEDY



Stantec

Mayfield Road Development at Kennedy Road
Stormwater Management Design Brief
City of Brampton, Town of Caledon

CFN 36211

Prepared for:

Toronto and Region Conservation Authority
Development Services Section
5 Shoreham Drive
Downsview ON M3N 2S4

Prepared by:

Stantec Consulting Ltd.
49 Frederick Street
Kitchener ON N2H 6M7
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Date: December 12, 2007
Project No. 602 10320-03/30

Stantec Consulting Ltd.
49 Frederick Street
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Tel: (519) 579-4410
stantec.com

Stantec

December 6, 2007
File: 602-10320

Attention: Mr. Dave Hallman

Dear Mr. Hallman:

Reference: Mayfield Road Development at Kennedy Road
Stormwater Management Design Brief
City of Brampton, Town of Caledon

The purpose of this design brief is to address the water quality and water quantity concerns associated with the widening of Mayfield Road, in the Region of Peel, as recommended by the Environmental Assessment (EA) process and as described in the Environmental Study Report (ESR) by Stantec Consulting, November 2002. This brief has been prepared in support of the proposed stormwater management facility located north of Mayfield Road near Kennedy Road.

The drainage area consists of approximately 10.59 ha and includes the road right-of-way and additional areas along Mayfield Road near the intersection of Mayfield Road and Kennedy Road, which drain to the roadway. Drainage from lands external to the road right-of-way is accepted at existing condition rates, however any future development within these areas will be required to direct runoff to other areas or to provide their own water quality and water quantity controls. Discharge from the study area flows into the provincially significant Heart Lake Wetland to the north.

The following design brief outlines the stormwater management design and results for the proposed development.

Existing Conditions

The 10.59 ha area is relatively flat and located along Mayfield Road near Kennedy Road in the City of Brampton. Mayfield Road and Kennedy Road are both two-lane roads that have been in existence for many years. The surrounding area is predominantly agricultural with some wetland areas north of Mayfield Road, and a combination of agricultural and residential land uses south of Mayfield Road.

**Reference: Mayfield Road Development at Kennedy Road
Stormwater Management Design Brief**

The subject lands are moderately flat, with all drainage entering the Heart Lake Wetland. Borehole results, completed by Thurber Engineering Ltd., indicate that the native soil is comprised of a clayey silt glacial till. The native soil is overlain by granular fill along the roadway, and by a layer of peat in the wetlands. Peat also extends under the Mayfield Road – Kennedy Road intersection.

Proposed Conditions

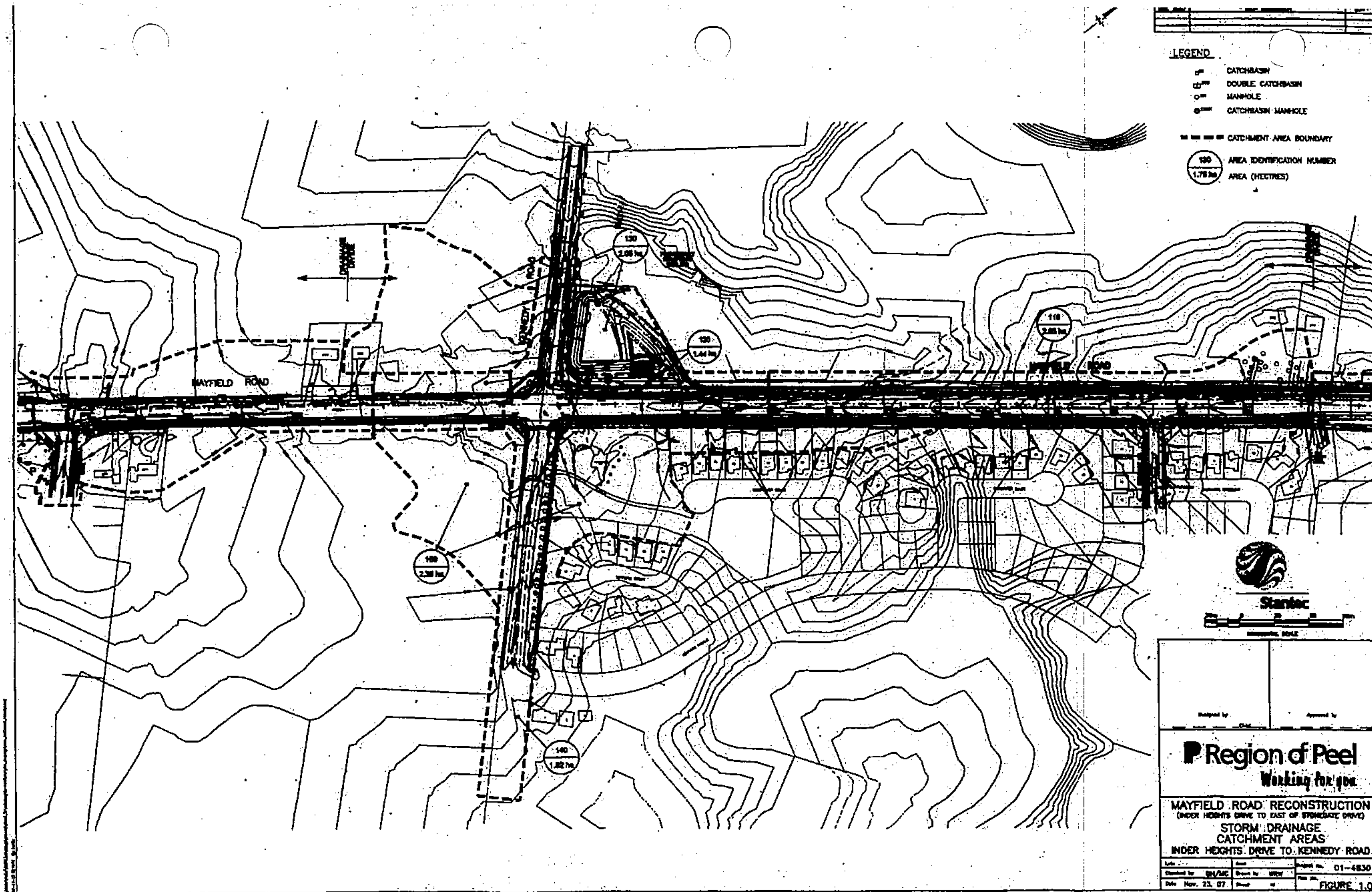
The proposed development includes widening Mayfield Road, and adding appropriate turning lanes around the Mayfield and Kennedy Road intersection to accommodate increased traffic.

The proposed catchment areas are generally grouped into areas with similar conditions (e.g., land use, etc.) and drainage direction. The proposed drainage conditions for the 10.59 ha site can be seen in Figure 1.0 and are summarized as follows:

- Catchment 110: Runoff from approximately 2.93 ha from Mayfield Road east of Kennedy Road. The ultimate Mayfield Road cross-section (six lanes of traffic) and pedestrian pathways have been assumed.
- Catchment 120: Drainage from approximately 1.44 ha from Mayfield Road near Kennedy Road. The ultimate Mayfield Road cross-section including turning lanes (eight lanes of traffic) and pedestrian pathways have been assumed.
- Catchment 130: Runoff from approximately 2.05 ha from agricultural areas to the north and west of the Mayfield and Kennedy Road Intersection and the stormwater management facility.
- Catchment 140: Drainage from approximately 1.82 ha from Kennedy Road north and south of Mayfield Road. The ultimate Kennedy Road cross-section including turning lanes (six lanes of traffic) and pedestrian pathways have been assumed.
- Catchment 150: Drainage from the remaining 2.35 ha from areas to the south and east of Mayfield Road at Kennedy Road including agricultural areas and Kingfisher Park.

Stormwater Management Design

In accordance with the approved design concept, the proposed SWM plan for the current development includes a small constructed wetland to provide the water quality, water quantity, and erosion control before discharging to the Heart Lake Wetland. The stormwater management pond will be located north of the Mayfield Road and Kennedy Road intersection. All drainage from the roadways as well as the existing surrounding drainage areas will be



LEGEND
CATCHBASIN
DOUBLE CATCHBASIN
MANHOLE
CATCHBASIN MANHOLE
CATCHMENT AREA BOUNDARY
AREA IDENTIFICATION NUMBER
AREA (HECTRES)
MAYFIELD ROAD
KENNEDY ROAD
110
120
1.44 ha
130
2.08 ha
100
2.38 ha
140
1.82 ha
Stantec
Region of Peel
Working for you
MAYFIELD ROAD RECONSTRUCTION
STORM DRAINAGE
CATCHMENT AREAS
INDER HEIGHTS DRIVE TO KENNEDY ROAD
Date Nov. 23, 07
01-4830
FIGURE 1.0

**Reference: Mayfield Road Development at Kennedy Road
Stormwater Management Design Brief**

directed to the stormwater management pond. Discharge from the pond will be a diffuse flow rather than a direct channel, to minimize impacts on the wetland.

Based on the recommendations from the ESR, the stormwater management criteria applied in the current design of the pond are as follows:

- Water Quality Storage – provide sufficient permanent pool and extended detention volume to meet MOE "Enhanced" criteria (i.e., 80% long term suspended solids removal), as identified in Table 3.2 of the MOE *Stormwater Management Planning and Design Manual*, (March 2003)

- Erosion Control Storage – provide extended detention storage in the pond to detain the runoff from a 4 hour- 25 mm storm for a minimum of ~~24~~ 48 hours. Water Quality storage is included in Erosion Control storage.

- Water Quantity Control – according to the ESR, peak flow attenuation for flood control is not required at this location. However, discussion with Toronto and Region Conservation Authority staff confirmed that proposed flows must be maintained at or below existing flow rates for all rainfall events up to and including the Regional Strom.

As a part of the SWM pond analysis, peak flow values were calculated using SWMHYMO (StormWater Management HYdrologic MOdel) for the 25 mm (first flush) through Regional Storm events. Rainfall data was based on the 6-hour AES storm distributions for Toronto, Ontario. An average ground slope of 2% and a Soil Conservation Service CN number of 75 were assumed. Peak flow rates are summarized in Table 1. Detailed modelling files are included in Appendix A.

Table 1: Storm Event Data

	Storm Event					
	25 mm	**2 year**	**5 year**	**10 year**	**100 year**	**Regional**
Existing Peak Flow (m^3/s)	0.117	0.253	0.437	0.575	1.074	1.440
Proposed Peak Flow (m^3/s)	0.032	0.044	0.166	0.303	0.802	1.431
Active Pond Depth (m)	0.45	0.67	0.82	0.88	1.01	1.14
Maximum Pond Elevation (m)	256.00	256.22	256.37	256.43	256.56	256.69
Drawdown Time (hours)	48.9	53.3	55.2	55.4	55.7	55.8

The design of the pond is illustrated on Drawing 36211-SW1 (Mayfield Road Reconstruction (Inder Heights Drive to Heart Lake Road) Storm Water Management – Kennedy Road Pond), and proposes a constructed wetland configuration to provide enhanced water quality control, with a maximum ponding elevation of approximately 256.56 m under the 100-year Chicago storm. A sediment forebay has been included in the design to allow for the centralized collection of sediment for ease of removal. In addition to the permanent pool characteristics, the pond will provide sufficient extended detention storage to achieve a 38-hour drawdown of the MOE water quality control volumes, and an approximately 49-hour detention time for the erosion control volume.

The outlet from the constructed wetland pond will consist of a fully perforated 1500 mm diameter riser in the northwest corner of the pond. Within the vertical riser, a 375 mm diameter outlet pipe will be installed with two orifice holes. A 95 mm diameter orifice will provide the necessary detention time for the water quality component of extended detention, with a 150 mm diameter orifice providing the control for the erosion component of extended detention. The outlet pipe discharges to a Ditch Inlet Catch Basin (DICB) near the Heart Lake Wetland. The DICB then flows into a gabion basket, where low flows are free to upwell to the surface (255.3 m), and discharge into the Heart Lake Wetland under diffuse, non-erosive conditions. Higher flows are discharged directly from the DICB at an elevation of 255.55 m (the permanent pool elevation). Runoff in excess of the extended detention volumes will be discharged via the orifice structures and an overflow weir (256.30 m). Erosion protection is provided along the overflow weir structure using a Maccaferri MacMat® N10 vegetated turf reinforcement mat. The maximum weir velocity is 1.3 m/s during a 100-year Chicago storm, while the turf reinforcement mat is designed for velocities up to 5 m/s. The outlet structure is detailed on Drawing 36211-SW1.

Table 2 lists the pond design characteristics. An average impervious coverage of 41% has been calculated for the area tributary to the pond. For a wetland forebay, it is recommended in the MOE *Stormwater Management Planning and Design Manual* that the surface area of deeper areas be less than 20% of the total permanent pool surface area. For the Mayfield and Kennedy Road pond the forebay represents 28% of the surface area. This was deemed to be acceptable because the permanent pool volume in the top 0.3 m of the pond area including the forebay is 524 m^3, which is greater than the required volume (503 m^3). All design calculations are provided in Appendix B. The underlying soil is sandy in nature and the SWM pond will be lined with impermeable material in order to maintain the permanent pool.

**Reference: Mayfield Road Development at Kennedy Road
Stormwater Management Design Brief**

Table 2: Pond Characteristics

Parameter	Basin Characteristics
Total Contributing Area	10.59ha
Total Percent Impervious	41 %
Pond Bottom Elevation	255.25 m
Permanent Pool Elevation	255.55 m
Pond Top Elevation	256.9 m
High Water Level (100 Year Storm Event)	256.56m
Freeboard Provided Above High Water Level	0.34 m
Quality Control (Enhanced)	
Unit Area Storage Requirement	88 m^3/ha
Permanent Pool Volume Required (48 m^3/ha)	503 m^3
Permanent Pool Volume Provided in Pond	718 m^3
Permanent Pool Depth in Main Pond	0.3 m
Extended Detention Volume Required (40 m^3/ha)	424m^3
Extended Detention Volume Provided in Pond	435 m^3
Extended Detention Time	38 hrs
Erosion Control	
Erosion Control Volume Required (maximum storage volume during the 25 mm rainfall event)	1058 m^3
Erosion Control Volume Provided in Pond	1902 m^3
Erosion Control Detention Time	48.9 hrs
Forebay	
Length Required	15 m
Length Provided	40 m
Maximum Sediment Accumulation Depth	0.5 m
Cleanout Frequency	~8 yrs
Surface Area of Forebay Compared to Total Area	28%
Outlet Details	
Orifice #1 Diameter	95 mm
Orifice #1 Invert Elevation	255.55 m
Orifice #2 Diameter	150 mm
Orifice #2 Invert Elevation	255.75 m
Overflow Weir Width	3 m
Overflow Weir Invert Elevation	256.30m

Reference: Mayfield Road Development at Kennedy Road Stormwater Management Design Brief

Water Balance

The study area flows into the provincially significant Heart Lake Wetland. To ensure that the wetland stays wet after the proposed development occurs, the runoff volume from the more frequent modelled events are examined and shown in Table 3. As expected, the volume of surface water runoff to the wetland increased under the proposed development conditions for all storm events.

Table 3: Change in Runoff Volumes to Heart Lake Wetland

Storm Event	Existing Runoff Volume (m^3)	Proposed Runoff Volume (m^3)	Increase in Runoff Volume (m^3)
25 mm	612	1335	723
2 Year	865	1697	833
5 Year	1501	2532	1031

Average annual water balance calculations, contained in Appendix B, show that the average annual runoff to the wetland will increase by approximately 22,000 m^3/year. Since the wetland has an outlet under Mayfield Road, which will be retained under proposed conditions, the increase in runoff volume should not result in increased ponding in the wetland since peak flows are controlled to less than existing conditions.

Maintenance Report

Monitoring and maintenance activities are an important part of a stormwater management plan to ensure that the designed features continue to operate as intended. Long term monitoring and maintenance should involve annual inspections of the stormwater management facilities and downstream areas. The following section is intended to provide guidance for long term maintenance of the stormwater management facility.

- Annual Inspections – during annual inspections, the following items should be recorded:
  - Is the regular pond level above or below the permanent pool elevation (255.55m)?
  - Damage to facility structures including headwalls, pipes, DICB, berms, maintenance accesses, etc.
  - Condition of vegetation
  - Visual characteristics of ponded water in facility (i.e. oily sheen, colour, etc.)
  - Sediment depth and oil accumulation in wetland forebay

- Erosion around outlet structure (overflow weir and gabion basket) or downstream areas

- Annual Maintenance – tasks to be performed during, or as a result of, annual inspections
  - Clear blockages and repair damage to SWM facility structures including inlet and outlet pipes, outlet risers, inlet manholes
  - Clear accumulated debris from stone jacket around riser. Any trash or debris removed from around the SWM facility should be disposed of in a legal and appropriate location
  - Inspect and repair erosion. Install slope reinforcement products or revegetate as necessary
  - Sediment must be removed from the facility after a period of approximately 8 years. Sediment should be removed from the forebays when sediment accumulation reaches 254.5 m or when sediment depths reach 0.5 m. This will equate to a water depth in the forebay of approximately 1.05 m if permanent pool elevations remain as designed.

- Forebay Maintenance Guidelines
  - Gravity drainage of the pond is not possible because ground elevations in the surrounding Heart Lake Wetland are similar to those within the pond. Draining of the pond will be accomplished through pumping when maintenance is required. The pond should be pumped out over a 24 hour period in order to reduce peak flows to the wetland
  - Removal and disposal of sediment from all facilities should be completed by a qualified party and/or licensed contractor.
  - An annual loading rate of 1.0 m^3/ha was assumed based on the average catchment imperviousness of 41% and Table 6.3 of the MOE *Stormwater Management Planning and Design Manual*, (March 2003). Sediment accumulation should be monitored and clean-out frequency confirmed over an extended period to ensure that sediment depths do not exceed 0.5 m.

- Liner Maintenance Guidelines
  - In the event that the liner fails, the recommended Bentofix repair scheme should be implemented

**Reference: Mayfield Road Development at Kennedy Road
Stormwater Management Design Brief**

Conclusions

Based on the preceding report, the following conclusions can be made:

- The proposed stormwater management facility will provide sufficient storage and extended detention control to achieve an Enhanced (formerly Level 1) level of water quality control and erosion protection for the development lands.
- The pond outlet to the Heart Lake Wetland incorporates sufficient diffusive flow mechanisms to ensure that erosion does not occur using a gabion basket.
- The proposed discharge rates from the pond are at or below existing flow rates.
- The volume of surface water runoff to the Heart Lake Wetland will increase under the proposed development conditions.

The SWM facility at Mayfield and Kennedy Road is designed to provide controls where applicable without manual manipulation and operate solely based on hydraulic principles. As long as the facility is constructed as designed, the above maintenance procedures are followed and repairs performed as necessary, their performance should be acceptable.

We trust this report is sufficient to obtain approvals for a Stormwater Management Pond for the proposed development. Should you have any questions or comments relating to this design, please do not hesitate to contact the undersigned at your convenience.

Sincerely,

STANTEC CONSULTING LTD.

LICENSED PROFESSIONAL ENGINEER
06/12/07
J. A. M. INNES
100012372
PROVINCE OF ONTARIO

Jayson Innes, MASc., P.Eng.
Water Resources Engineer
Tel: (519) 585-7282
Fax: (519) 579-8664
jinnes@stantec.com

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APPENDIX A

SWMHYMO FILES

Mayfield Road at Kennedy Road
Storm Drainage Plan
Project Number: 602-10320

Description	Area	Existing		Proposed	
		Imperv.	Imperv.	Imperv.	Imperv.
	(ha)	(%)	(ha)	(%)	(ha)
Mayfield Road east of Kennedy Road	0.30	20	0.06	62	0.19
Mayfield Road east of Kennedy Road	0.28	20	0.06	62	0.17
Mayfield Road east of Kennedy Road	0.29	20	0.06	62	0.18
Mayfield Road east of Kennedy Road	0.25	20	0.05	62	0.16
Mayfield Road east of Kennedy Road	0.25	20	0.05	62	0.16
Mayfield Road east of Kennedy Road	0.25	20	0.05	62	0.16
Mayfield Road east of Kennedy Road	0.25	20	0.05	62	0.16
Mayfield Road east of Kennedy Road	0.25	20	0.05	62	0.16
Mayfield Road east of Kennedy Road	0.25	20	0.05	62	0.16
Agricultural land along Mayfield Road	0.20	0	0	0	0
Agricultural land along Mayfield Road	0.04	0	0	0	0
Agricultural land along Mayfield Road	0.07	0	0	0	0
Agricultural land along Mayfield Road	0.15	0	0	0	0
Agricultural land along Mayfield Road	0.1	0	0	0	0
Subcatchment 110 Total	**2.93**	**16**	**0.47**	**50**	**1.47**
Mayfield Road near Kennedy Road	0.2	20	0.04	88	0.18
Mayfield Road near Kennedy Road	0.18	20	0.04	88	0.16
Mayfield Road near Kennedy Road	0.45	20	0.09	88	0.40
Mayfield Road near Kennedy Road	0.03	20	0.01	88	0.03
Mayfield Road near Kennedy Road	0.14	20	0.03	88	0.12
Mayfield Road near Kennedy Road	0.1	20	0.02	88	0.09
Mayfield Road near Kennedy Road	0.34	20	0.07	88	0.30
Subcatchment 120 Total	**1.44**	**20**	**0.288**	**88**	**1.27**
SWM facility N of Mayfield and Kennedy Road	0.53	0	0	35	0.19
Agricultural land W of Mayfield and Kennedy Road	1.52	0	0	0	0
Subcatchment 130 Total	**2.05**	**0**	**0**	**9**	**0.19**
Kennedy Road S of Mayfield	0.54	20	0.11	75	0.41
Kennedy Road S of Mayfield	0.27	20	0.05	75	0.20
Kennedy Road S of Mayfield	0.12	20	0.02	75	0.09
Kennedy Road S of Mayfield	0.39	21	0.08	76	0.30
Kennedy Road N of Mayfield	0.5	20	0.10	75	0.38
Subcatchment 140 Total	**1.82**	**20**	**0.37**	**75**	**1.37**
Agricultural land SW of Mayfield and Kennedy Road	1.12	0	0.00	0	0.00
Kingfisher Park	1.23	5	0.06	5	0.06
Subcatchment 150 Total	**2.35**	**3**	**0.06**	**3**	**0.06**
Catchment Total	**10.59**	**11**	**1.19**	**41**	**4.35**

602 - 10320 Mayfield Road at Kennedy Road
SWMHYMO Parameters

Existing conditions

Area Description	Catchment Number	SWMHYMO Command	Area (ha)	CN	XIMP	TIMP	Slope (%)	Length (m)	Slope (%)	Tc (hrs)	Tp (hrs)
Mayfield Rd East of Kennedy Rd.	110	DESIGN STANDHYD	2.93	75	0.01	0.16	2.0		2.0		
Mayfield Rd at Kennedy Rd	120	DESIGN STANDHYD	1.44	75	0.01	0.20	2.0		2.0		
Mayfield Rd Grass Areas	130	DESIGN NASHHYD	2.05	75		0.00	2.0	117	2.0	0.42	0.25
Kennedy Road	140	DESIGN STANDHYD	1.82	75	0.01	0.20	2.0		2.0		
South Kennedy Grass Areas	150	DESIGN NASHHYD	2.35	75		0.03	2.0	125	2.0	0.44	0.26
			10.59								

Proposed Conditions

Area Description	Catchment Number	SWMHYMO Command	Area (ha)	CN	XIMP	TIMP	Slope (%)	Length (m)	Slope (%)	Tc (hrs)	Tp (hrs)
Mayfield Rd East of Kennedy Rd.	110	DESIGN STANDHYD	2.93	75	0.50	0.50	2.0		2.0		
Mayfield Rd at Kennedy Rd	120	DESIGN STANDHYD	1.44	75	0.88	0.88	2.0		2.0		
Mayfield Rd Grass Areas	130	DESIGN NASHHYD	2.05	77		0.09	2.0	117	2.0	0.42	0.25
Kennedy Road	140	DESIGN STANDHYD	1.82	75	0.75	0.75	2.0		2.0		
South Kennedy Grass Areas	150	DESIGN NASHHYD	2.35	75		0.03	2.0	125	2.0	0.44	0.26
			10.59								

Notes:

CN calculated for pervious areas only for DESIGN STANDHYD. CN is a weighed average for DESIGN NASHYD

TIMP ——→ *Total percent impervious*

XIMP ——→ *Percent impervious directly connected*

IA ——→ $Tc = [\,3.26\,(1.1 - C)\,L^{0.5}\,] / S^{0.33}$

Where: C = *Runoff Coefficient = 0.2 for undeveloped areas*

L = *Length of Overland Flow (m)*

= *(Area/1.5)^0.5*

S = *Slope (%)*

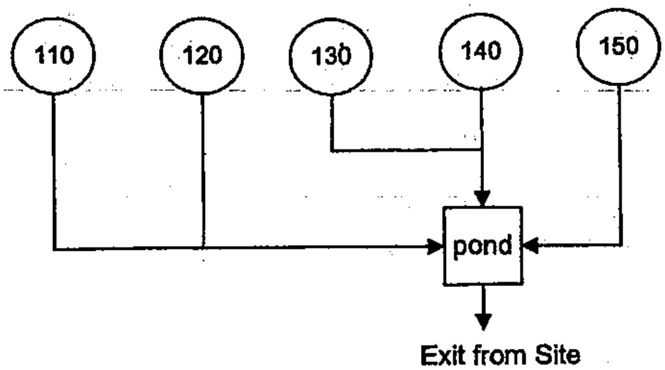
Time of Concentration calculated using the Airport Method

Time to Peak ——→ $Tp = 0.6Tc$

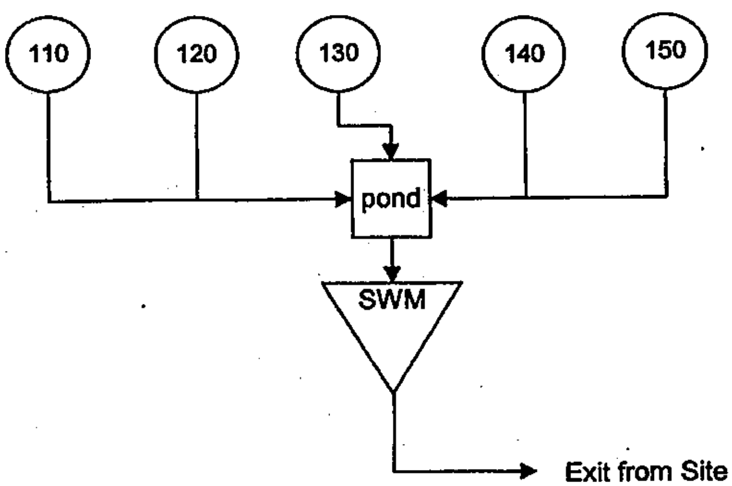
XIMP for existing condtions based on a 9 m roadway

602 - 10320 Mayfield Road at Kennedy Road
SYMHYMO Schematics

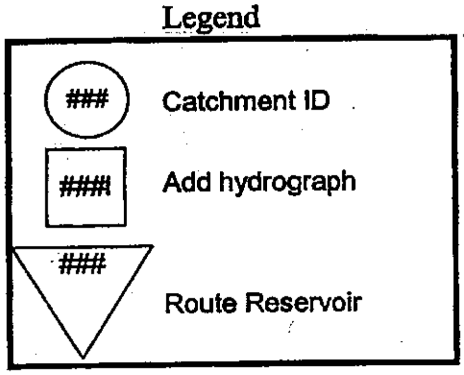
Existing Conditions



Proposed Conditions



Legend



```
;     Metric units
*#****************************************************************************
*#  Project Name: [Mayfield Road]     Project Number: [602-10320]
*#  Date          : June, 2007
*#  Modeller      : [Dan McCreery]
*#  Company       : Stantec Consulting Ltd. (Kitchener)
*#  License #     : 4730904
*#****************************************************************************
*#****************************************************************************
START                 TZERO=[0.0], METOUT=[2], NSTORM=[1], NRUN=[1]
*%                     ["25mm4hr.stm"] <--storm filename, one per line for NSTORM
*%-------------------|------------------------------------------------------|
READ STORM            STORM_FILENAME=["Storm.001"]
*%-------------------|------------------------------------------------------|
*#****************************************************************************
*#      The following info is based on the Storm Drainage Plan
*#****************************************************************************
*#****************************************************************************
*#      Mayfield Rd East of Kennedy Rd.
*#****************************************************************************
*%-------------------|------------------------------------------------------|
DESIGN STANDHYD       ID=[1], NHYD=["110"], DT=[1]min, AREA=[2.93](ha),
                      XIMP=[0.01], TIMP=[0.16], DWF=[0](cms), LOSS=[2], CN=[75]
                      SLOPE=[2](%), RAINFALL=[ , , , , ](mm/hr), END=-1
*#****************************************************************************
*#      Mayfield Rd at Kennedy Rd
*#****************************************************************************
*%-------------------|------------------------------------------------------|
DESIGN STANDHYD       ID=[2], NHYD=["120"], DT=[1]min, AREA=[1.44](ha),
                      XIMP=[0.01], TIMP=[0.20], DWF=[0](cms), LOSS=[2], CN=[75]
                      SLOPE=[2](%), RAINFALL=[ , , , , ](mm/hr), END=-1
*#****************************************************************************
*#      Mayfield Rd Grass Areas
*#****************************************************************************
*%-------------------|------------------------------------------------------|
DESIGN NASHYD         ID=[3], NHYD=["130"], DT=[1]min, AREA=[2.05](ha),
                      DWF=[0](cms), CN/C=[75], TP=[0.25]hrs,
                      RAINFALL=[ , , , , ](mm/hr), END=-1
*#****************************************************************************
*#      Kennedy Road
*#****************************************************************************
*%-------------------|------------------------------------------------------|
DESIGN STANDHYD       ID=[4], NHYD=["140"], DT=[1]min, AREA=[1.82](ha),
                      XIMP=[0.01], TIMP=[0.20], DWF=[0](cms), LOSS=[2], CN=[75]
                      SLOPE=[2](%), RAINFALL=[ , , , , ](mm/hr), END=-1
*#****************************************************************************
*#      South Kennedy Grass Areas
*#****************************************************************************
*%-------------------|------------------------------------------------------|
DESIGN NASHYD         ID=[5], NHYD=["150"], DT=[1]min, AREA=[2.35](ha),
                      DWF=[0](cms), CN/C=[75], TP=[0.26]hrs,
                      RAINFALL=[ , , , , ](mm/hr), END=-1
*%-------------------|------------------------------------------------------|
ADD HYD               IDsum=[6], NHYD=["pond"], IDs to add=[1+2+3+4+5]
*%-------------------|------------------------------------------------------|
PRINT HYD             ID=[6], # OF PCYCLES=[0]
*%-------------------|------------------------------------------------------|
*%-------------------|------------------------------------------------------|
START                 TZERO=[0.0], METOUT=[2], NSTORM=[1], NRUN=[2]
*%                     ["2y6hAES.stm"] <--storm filename, one per line for NSTORM
*%-------------------|------------------------------------------------------|
START                 TZERO=[0.0], METOUT=[2], NSTORM=[1], NRUN=[3]
*%                     ["5y6hAES.stm"] <--storm filename, one per line for NSTORM
*%-------------------|------------------------------------------------------|
START                 TZERO=[0.0], METOUT=[2], NSTORM=[1], NRUN=[4]
*%                     ["10y6hAES.stm"] <--storm filename, one per line for NSTORM
*%-------------------|------------------------------------------------------|
START                 TZERO=[0.0], METOUT=[2], NSTORM=[1], NRUN=[5]
*%                     ["25y6hAES.stm"] <--storm filename, one per line for NSTORM
*%-------------------|------------------------------------------------------|
START                 TZERO=[0.0], METOUT=[2], NSTORM=[1], NRUN=[6]
*%                     ["50y6hAES.stm"] <--storm filename, one per line for NSTORM
*%-------------------|------------------------------------------------------|
START                 TZERO=[0.0], METOUT=[2], NSTORM=[1], NRUN=[7]
*%                     ["1006hAES.stm"] <--storm filename, one per line for NSTORM
*%-------------------|------------------------------------------------------|
START                 TZERO=[0.0], METOUT=[2], NSTORM=[1], NRUN=[8]
*%                     ["hurhaz48.stm"] <--storm filename, one per line for NSTORM
*%-------------------|------------------------------------------------------|
*%-------------------|------------------------------------------------------|
FINISH
```

```
*****************************************************************************
SSSSS  W   W  M   M  H   H  Y   Y  M   M   OOO        999    999  ========
S      W W W  MM MM  H   H   Y Y   MM MM  O   O      9   9  9   9
SSSSS  W W W  M M M  HHHHH    Y    M M M  O   O  ##  9   9  9   9  Ver. 4.02
    S  W W    M   M  H   H    Y    M   M  O   O       9999   9999  July 1999
SSSSS  W W    M   M  H   H    Y    M   M   OOO           9      9  ========
                                                     9   9  9   9  # 4730904
    StormWater Management HYdrologic Model            999    999   ========

*****************************************************************************
************************* SWMHYMO-99 Ver/4.02 ******************************
*******    A single event and continuous hydrologic simulation model  *******
*******       based on the principles of HYMO and its successors      *******
*******                OTTHYMO-83 and OTTHYMO-89.                     *******
*****************************************************************************
******* Distributed by:  J.F. Sabourin and Associates Inc.            *******
*******                  Ottawa, Ontario: (613) 727-5199              *******
*******                  Gatineau, Quebec: (819) 243-6858             *******
*******                  E-Mail: swmhymo@jfsa.Com                     *******
*****************************************************************************

*****************************************************************************
******* Licensed user: Stantec Consulting Ltd. (Kitchener)            *******
*******                Kitchener             SERIAL#:4730904           *******
*****************************************************************************

*****************************************************************************
*******           ++++++ PROGRAM ARRAY DIMENSIONS ++++++               *******
*******           Maximum value for ID numbers   :    10               *******
*******           Max. number of rainfall points:  15000               *******
*******           Max. number of flow points    :  15000               *******
*****************************************************************************

*** DESCRIPTION SUMMARY TABLE HEADERS (units depend on METOUT in START) ***
-----------------------------------------------------------------------------
***        ID:  Hydrograph IDentification numbers, (1-10).                ***
***      NHYD:  Hydrograph reference numbers, (6 digits or characters).   ***
***      AREA:  Drainage area associated with hydrograph, (ac.) or (ha.). ***
***     QPEAK:  Peak flow of simulated hydrograph, (ft^3/s) or (m^3/s).   ***
*** TpeakDate_hh:mm is the date and time of the peak flow.                ***
***      R.V.:  Runoff Volume of simulated hydrograph, (in) or (mm).      ***
***      R.C.:  Runoff Coefficient of simulated hydrograph, (ratio).      ***
***        *:   see WARNING or NOTE message printed at end of run.        ***
***       **:   see  ERROR  message printed at end of run.                ***
*****************************************************************************

:::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::

*****************************************************************************

********************  S U M M A R Y   O U T P U T  *************************
*****************************************************************************
*      DATE: 2007-07-16       TIME: 14:27:55        RUN COUNTER: 000201     *
*****************************************************************************
* Input    filename: C:\DOCUME~1\DMCCRE~1\MYDOCU~1\MAYFIE~2\kenpre07.dat    *
* Output   filename: C:\DOCUME~1\DMCCRE~1\MYDOCU~1\MAYFIE~2\kenpre07.out    *
* Summary  filename: C:\DOCUME~1\DMCCRE~1\MYDOCU~1\MAYFIE~2\kenpre07.sum    *
* User comments:                                                            *
* 1:________________________________________________________________________*
* 2:________________________________________________________________________*
* 3:________________________________________________________________________*
*****************************************************************************

#****************************************************************************
# Project Name: [Mayfield Road]     Project Number: [602-10320]
# Date        : June, 2007
# Modeller    : [Dan McCreery]
# Company     : Stantec Consulting Ltd. (Kitchener)
# License #   : 4730904
#****************************************************************************
#****************************************************************************
RUN:COMMAND#
001:0001--------------------------------------------------------------------
   START
    [TZERO =     .00 hrs on        0]
    [METOUT=    2    (1=imperial, 2=metric output)]
    [NSTORM=    1 ]
    [NRUN  =    1 ]
001:0002--------------------------------------------------------------------
   READ STORM
    Filename = Storm.001
    Comment  = Twenty five mm Four Hour Chicago Storm
    [SDT=10.00:SDUR=    4.00:PTOT=   25.00]
#****************************************************************************
#     The following info is based on the Storm Drainage Plan
#****************************************************************************
#****************************************************************************
#     Mayfield Rd East of Kennedy Rd.
#****************************************************************************
001:0003---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
 * DESIGN STANDHYD      01:110         2.93     .031 No_date    1:52     6.07 .243
    [XIMP=.01:TIMP=.16]
    [SLP=2.00:DT= 1.00]
    [LOSS= 2 :CN= 75.0]
#****************************************************************************
#     Mayfield Rd at Kennedy Rd
#****************************************************************************
001:0004---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
   DESIGN STANDHYD      02:120         1.44     .017 No_date    1:50     6.32 .253
    [XIMP=.01:TIMP=.20]
    [SLP=2.00:DT= 1.00]
    [LOSS= 2 :CN= 75.0]
#****************************************************************************
#     Mayfield Rd Grass Areas
#****************************************************************************
001:0005---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
   DESIGN NASHYD        03:130         2.05     .023 No_date    1:46     5.10 .204
    [CN= 75.0: N= 3.00]
    [Tp=  .25:DT= 1.00]
#****************************************************************************
#     Kennedy Road
#****************************************************************************
001:0006---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
   DESIGN STANDHYD      04:140         1.82     .021 No_date    1:50     6.32 .253
    [XIMP=.01:TIMP=.20]
    [SLP=2.00:DT= 1.00]
    [LOSS= 2 :CN= 75.0]
#****************************************************************************
#     South Kennedy Grass Areas
#****************************************************************************
001:0007---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
   DESIGN NASHYD        05:150         2.35     .026 No_date    1:47     5.10 .204
    [CN= 75.0: N= 3.00]
    [Tp=  .26:DT= 1.00]
001:0008---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
   ADD HYD              01:110         2.93     .031 No_date    1:52     6.07  n/a
                      + 02:120         1.44     .017 No_date    1:50     6.32  n/a
                      + 03:130         2.05     .023 No_date    1:46     5.10  n/a
                      + 04:140         1.82     .021 No_date    1:50     6.32  n/a
                      + 05:150         2.35     .026 No_date    1:47     5.10  n/a
    [DT= 1.00]  SUM=    06:pond       10.59     .117 No_date    1:50     5.75  n/a
001:0009---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
   PRINT HYD            06:pond       10.59     .117 No_date    1:50     5.75  n/a
 ** END OF RUN :   1

*****************************************************************************

RUN:COMMAND#
002:0001--------------------------------------------------------------------
   START
    [TZERO =     .00 hrs on        0]
    [METOUT=    2    (1=imperial, 2=metric output)]
    [NSTORM=    1 ]
    [NRUN  =    2 ]
#****************************************************************************
# Project Name: [Mayfield Road]     Project Number: [602-10320]
# Date        : June, 2007
# Modeller    : [Dan McCreery]
# Company     : Stantec Consulting Ltd. (Kitchener)
# License #   : 4730904
#****************************************************************************
#****************************************************************************
002:0002--------------------------------------------------------------------
   READ STORM
    Filename = Storm.001
    Comment  = 2yr/6hr
    [SDT=15.00:SDUR=    6.25:PTOT=   36.00]
#****************************************************************************
#     The following info is based on the Storm Drainage Plan
#****************************************************************************
#****************************************************************************
#     Mayfield Rd East of Kennedy Rd.
#****************************************************************************
002:0003---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
 * DESIGN STANDHYD      01:110         2.93     .069 No_date    2:56    11.56 .321
    [XIMP=.01:TIMP=.16]
    [SLP=2.00:DT= 1.00]
    [LOSS= 2 :CN= 75.0]
#****************************************************************************
#     Mayfield Rd at Kennedy Rd
#****************************************************************************
002:0004---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
   DESIGN STANDHYD      02:120         1.44     .036 No_date    2:55    11.96 .332
    [XIMP=.01:TIMP=.20]
    [SLP=2.00:DT= 1.00]
    [LOSS= 2 :CN= 75.0]
#****************************************************************************
#     Mayfield Rd Grass Areas
#****************************************************************************
002:0005---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
   DESIGN NASHYD        03:130         2.05     .048 No_date    2:52     9.99 .277
    [CN= 75.0: N= 3.00]
    [Tp=  .25:DT= 1.00]
#****************************************************************************
#     Kennedy Road
#****************************************************************************
002:0006---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
   DESIGN STANDHYD      04:140         1.82     .046 No_date    2:55    11.96 .332
    [XIMP=.01:TIMP=.20]
    [SLP=2.00:DT= 1.00]
    [LOSS= 2 :CN= 75.0]
#****************************************************************************
#     South Kennedy Grass Areas
#****************************************************************************
002:0007---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
   DESIGN NASHYD        05:150         2.35     .054 No_date    2:53     9.99 .277
    [CN= 75.0: N= 3.00]
    [Tp=  .26:DT= 1.00]
002:0008---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
   ADD HYD              01:110         2.93     .069 No_date    2:56    11.56  n/a
                      + 02:120         1.44     .036 No_date    2:55    11.96  n/a
                      + 03:130         2.05     .048 No_date    2:52     9.99  n/a
                      + 04:140         1.82     .046 No_date    2:55    11.96  n/a
                      + 05:150         2.35     .054 No_date    2:53     9.99  n/a
    [DT= 1.00]  SUM=    06:pond       10.59     .253 No_date    2:54    11.03  n/a
002:0009---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
   PRINT HYD            06:pond       10.59     .253 No_date    2:54    11.03  n/a
 ** END OF RUN :   2

*****************************************************************************

RUN:COMMAND#
003:0001--------------------------------------------------------------------
   START
    [TZERO =     .00 hrs on        0]
    [METOUT=    2    (1=imperial, 2=metric output)]
    [NSTORM=    1 ]
    [NRUN  =    3 ]
#****************************************************************************
# Project Name: [Mayfield Road]     Project Number: [602-10320]
# Date        : June, 2007
# Modeller    : [Dan McCreery]
# Company     : Stantec Consulting Ltd. (Kitchener)
# License #   : 4730904
#****************************************************************************
003:0002--------------------------------------------------------------------
   READ STORM
    Filename = Storm.001
```

```
     Comment  = 5yr/6hr
     [SDT=15.00:SDUR=   6.25:PTOT=  47.81]
#**************************************************************************
#     The following info is based on the Storm Drainage Plan
#**************************************************************************
#**************************************************************************
#     Mayfield Rd East of Kennedy Rd.
#**************************************************************************
 003:0003---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
  * DESIGN STANDHYD    01:110        2.93     .123 No_date    2:53   18.58 .389
     [XIMP=.01:TIMP=.16]
     [SLP=2.00:DT= 1.00]
     [LOSS= 2 :CN= 75.0]
#**************************************************************************
#     Mayfield Rd at Kennedy Rd
#**************************************************************************
 003:0004---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
   DESIGN STANDHYD    02:120        1.44     .064 No_date    2:52   19.16 .401
     [XIMP=.01:TIMP=.20]
     [SLP=2.00:DT= 1.00]
     [LOSS= 2 :CN= 75.0]
#**************************************************************************
#     Mayfield Rd Grass Areas
#**************************************************************************
 003:0005---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
   DESIGN NASHYD      03:130        2.05     .080 No_date    2:52   16.37 .342
     [CN= 75.0: N= 3.00]
     [Tp=  .25:DT= 1.00]
#**************************************************************************
#     Kennedy Road
#**************************************************************************
 003:0006---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
   DESIGN STANDHYD    04:140        1.82     .081 No_date    2:52   19.16 .401
     [XIMP=.01:TIMP=.20]
     [SLP=2.00:DT= 1.00]
     [LOSS= 2 :CN= 75.0]
#**************************************************************************
#     South Kennedy Grass Areas
#**************************************************************************
 003:0007---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
   DESIGN NASHYD      05:150        2.35     .090 No_date    2:53   16.37 .342
     [CN= 75.0: N= 3.00]
     [Tp=  .26:DT= 1.00]
 003:0008---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
   ADD HYD            01:110        2.93     .123 No_date    2:53   18.58  n/a
                    + 02:120        1.44     .064 No_date    2:52   19.16  n/a
                    + 03:130        2.05     .080 No_date    2:52   16.37  n/a
                    + 04:140        1.82     .081 No_date    2:52   19.16  n/a
                    + 05:150        2.35     .090 No_date    2:53   16.37  n/a
     [DT= 1.00]  SUM= 06:pond      10.59     .437 No_date    2:52   17.84  n/a
 003:0009---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
   PRINT HYD          06:pond      10.59     .437 No_date    2:52   17.84  n/a
 ** END OF RUN :    3

***************************************************************************



 RUN:COMMANDS
 004:0001-------------------------------------------------------------------
    START
     [TZERO =      .00 hrs on        0]
     [METOUT=    2    (1=imperial, 2=metric output)]
     [NSTORM=    1 ]
     [NRUN  =    4 ]
#**************************************************************************
#  Project Name: [Mayfield Road]    Project Number: [602-10320]
#  Date         : June, 2007
#  Modeller     : [Dan McCreery]
#  Company      : Stantec Consulting Ltd. (Kitchener)
#  License #    :  4730904
#**************************************************************************
#**************************************************************************
 004:0002-------------------------------------------------------------------
    READ STORM
     Filename = Storm.001
     Comment  = 10yr/6hr
     [SDT=15.00:SDUR=   6.25:PTOT=  55.69]
#**************************************************************************
#     The following info is based on the Storm Drainage Plan
#**************************************************************************
#**************************************************************************
#     Mayfield Rd East of Kennedy Rd.
#**************************************************************************
 004:0003---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
  * DESIGN STANDHYD    01:110        2.93     .163 No_date    2:52   23.77 .427
     [XIMP=.01:TIMP=.16]
     [SLP=2.00:DT= 1.00]
     [LOSS= 2 :CN= 75.0]
#**************************************************************************
#     Mayfield Rd at Kennedy Rd
#**************************************************************************
 004:0004---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
   DESIGN STANDHYD    02:120        1.44     .085 No_date    2:51   24.46 .439
     [XIMP=.01:TIMP=.20]
     [SLP=2.00:DT= 1.00]
     [LOSS= 2 :CN= 75.0]
#**************************************************************************
#     Mayfield Rd Grass Areas
#**************************************************************************
 004:0005---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
   DESIGN NASHYD      03:130        2.05     .104 No_date    2:52   21.15 .380
     [CN= 75.0: N= 3.00]
     [Tp=  .25:DT= 1.00]
#**************************************************************************
#     Kennedy Road
#**************************************************************************
 004:0006---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
   DESIGN STANDHYD    04:140        1.82     .107 No_date    2:51   24.46 .439
     [XIMP=.01:TIMP=.20]
     [SLP=2.00:DT= 1.00]
     [LOSS= 2 :CN= 75.0]
#**************************************************************************
#     South Kennedy Grass Areas
#**************************************************************************
 004:0007---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
   DESIGN NASHYD      05:150        2.35     .116 No_date    2:52   21.15 .380
     [CN= 75.0: N= 3.00]
     [Tp=  .26:DT= 1.00]
 004:0008---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
   ADD HYD            01:110        2.93     .163 No_date    2:52   23.77  n/a
                    + 02:120        1.44     .085 No_date    2:51   24.46  n/a
                    + 03:130        2.05     .104 No_date    2:52   21.15  n/a
                    + 04:140        1.82     .107 No_date    2:51   24.46  n/a
                    + 05:150        2.35     .116 No_date    2:52   21.15  n/a
     [DT= 1.00]  SUM= 06:pond      10.59     .575 No_date    2:52   22.89  n/a
 004:0009---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
   PRINT HYD          06:pond      10.59     .575 No_date    2:52   22.89  n/a
 ** END OF RUN :    4

***************************************************************************



 RUN:COMMANDS
 005:0001-------------------------------------------------------------------
    START
     [TZERO =      .00 hrs on        0]
     [METOUT=    2    (1=imperial, 2=metric output)]
     [NSTORM=    1 ]
     [NRUN  =    5 ]
#**************************************************************************
#  Project Name: [Mayfield Road]    Project Number: [602-10320]
#  Date         : June, 2007
#  Modeller     : [Dan McCreery]
#  Company      : Stantec Consulting Ltd. (Kitchener)
#  License #    :  4730904
#**************************************************************************
#**************************************************************************
 005:0002-------------------------------------------------------------------
    READ STORM
     Filename = Storm.001
     Comment  = 25yr/6hr
     [SDT=15.00:SDUR=   6.25:PTOT=  65.59]
#**************************************************************************
#     The following info is based on the Storm Drainage Plan
#**************************************************************************
#**************************************************************************
#     Mayfield Rd East of Kennedy Rd.
#**************************************************************************
 005:0003---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
  * DESIGN STANDHYD    01:110        2.93     .222 No_date    2:50   30.73 .468
     [XIMP=.01:TIMP=.16]
     [SLP=2.00:DT= 1.00]
     [LOSS= 2 :CN= 75.0]
#**************************************************************************
#     Mayfield Rd at Kennedy Rd
#**************************************************************************
 005:0004---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
   DESIGN STANDHYD    02:120        1.44     .115 No_date    2:49   31.55 .481
     [XIMP=.01:TIMP=.20]
     [SLP=2.00:DT= 1.00]
     [LOSS= 2 :CN= 75.0]
#**************************************************************************
#     Mayfield Rd Grass Areas
#**************************************************************************
 005:0005---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
   DESIGN NASHYD      03:130        2.05     .136 No_date    2:52   27.61 .421
     [CN= 75.0: N= 3.00]
     [Tp=  .25:DT= 1.00]
#**************************************************************************
#     Kennedy Road
#**************************************************************************
 005:0006---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
   DESIGN STANDHYD    04:140        1.82     .145 No_date    2:49   31.55 .481
     [XIMP=.01:TIMP=.20]
     [SLP=2.00:DT= 1.00]
     [LOSS= 2 :CN= 75.0]
#**************************************************************************
#     South Kennedy Grass Areas
#**************************************************************************
 005:0007---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
   DESIGN NASHYD      05:150        2.35     .153 No_date    2:52   27.61 .421
     [CN= 75.0: N= 3.00]
     [Tp=  .26:DT= 1.00]
 005:0008---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
   ADD HYD            01:110        2.93     .222 No_date    2:50   30.73  n/a
                    + 02:120        1.44     .115 No_date    2:49   31.55  n/a
                    + 03:130        2.05     .136 No_date    2:52   27.61  n/a
                    + 04:140        1.82     .145 No_date    2:49   31.55  n/a
                    + 05:150        2.35     .153 No_date    2:52   27.61  n/a
     [DT= 1.00]  SUM= 06:pond      10.59     .768 No_date    2:50   29.68  n/a
 005:0009---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
   PRINT HYD          06:pond      10.59     .768 No_date    2:50   29.68  n/a
 ** END OF RUN :    5

***************************************************************************



 RUN:COMMANDS
 006:0001-------------------------------------------------------------------
    START
     [TZERO =      .00 hrs on        0]
     [METOUT=    2    (1=imperial, 2=metric output)]
     [NSTORM=    1 ]
     [NRUN  =    6 ]
#**************************************************************************
#  Project Name: [Mayfield Road]    Project Number: [602-10320]
#  Date         : June, 2007
#  Modeller     : [Dan McCreery]
#  Company      : Stantec Consulting Ltd. (Kitchener)
#  License #    :  4730904
#**************************************************************************
#**************************************************************************
 006:0002-------------------------------------------------------------------
    READ STORM
     Filename = Storm.001
     Comment  = 50yr/6hr
     [SDT=15.00:SDUR=   6.25:PTOT=  73.00]
#**************************************************************************
#     The following info is based on the Storm Drainage Plan
#**************************************************************************
#**************************************************************************
```

```
#      Mayfield Rd East of Kennedy Rd.
#**************************************************************************
 006:0003---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
  * DESIGN STANDHYD     01:110        2.93     .269 No_date    2:49   36.20 .496
      [XIMP=.01:TIMP=.16]
      [SLP=2.00:DT= 1.00]
      [LOSS= 2 :CN= 75.0]
#**************************************************************************
#      Mayfield Rd at Kennedy Rd
#**************************************************************************
 006:0004---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
     DESIGN STANDHYD    02:120        1.44     .138 No_date    2:49   37.11 .508
      [XIMP=.01:TIMP=.20]
      [SLP=2.00:DT= 1.00]
      [LOSS= 2 :CN= 75.0]
#**************************************************************************
#      Mayfield Rd Grass Areas
#**************************************************************************
 006:0005---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
     DESIGN NASHYD      03:130        2.05     .162 No_date    2:52   32.74 .448
      [CN=75.0: N=3.00]
      [Tp=  .25:DT= 1.00]
#**************************************************************************
#      Kennedy Road
#**************************************************************************
 006:0006---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
     DESIGN STANDHYD    04:140        1.82     .174 No_date    2:48   37.11 .508
      [XIMP=.01:TIMP=.20]
      [SLP=2.00:DT= 1.00]
      [LOSS= 2 :CN= 75.0]
#**************************************************************************
#      South Kennedy Grass Areas
#**************************************************************************
 006:0007---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
     DESIGN NASHYD      05:150        2.35     .182 No_date    2:52   32.74 .448
      [CN= 75.0: N= 3.00]
      [Tp=  .26:DT= 1.00]
 006:0008---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
     ADD HYD            01:110        2.93     .269 No_date    2:49   36.20  n/a
                      + 02:120        1.44     .138 No_date    2:49   37.11  n/a
                      + 03:130        2.05     .162 No_date    2:52   32.74  n/a
                      + 04:140        1.82     .174 No_date    2:48   37.11  n/a
                      + 05:150        2.35     .182 No_date    2:52   32.74  n/a
       [DT= 1.00]  SUM= 06:pond      10.59     .919 No_date    2:50   35.04  n/a
 006:0009---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
     PRINT HYD          06:pond      10.59     .919 No_date    2:50   35.04  n/a
  ** END OF RUN :    6

***************************************************************************



 RUN:COMMAND#
 007:0001-------------------------------------------------------------------
     START
      [TZERO =     .00 hrs on        0]
      [METOUT=   2    (1=imperial, 2=metric output)]
      [NSTORM=   1 ]
      [NRUN   =  7 ]
#**************************************************************************
#  Project Name: [Mayfield Road]     Project Number: [602-10320]
#  Date          : June, 2007
#  Modeller      : [Dan McCreery]
#  Company       : Stantec Consulting Ltd. (Kitchener)
#  License #     :  4730904
#**************************************************************************
#**************************************************************************
 007:0002-------------------------------------------------------------------
     READ STORM
      Filename = Storm.001
      Comment  = 100yr/6hr
      [SDT=15.00:SDUR=   6.25:PTOT=  80.31]
#**************************************************************************
#      The following info is based on the Storm Drainage Plan
#**************************************************************************
#**************************************************************************
#      Mayfield Rd East of Kennedy Rd.
#**************************************************************************
 007:0003---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
  * DESIGN STANDHYD     01:110        2.93     .315 No_date    2:48   41.79 .520
      [XIMP=.01:TIMP=.16]
      [SLP=2.00:DT= 1.00]
      [LOSS= 2 :CN= 75.0]
#**************************************************************************
#      Mayfield Rd at Kennedy Rd
#**************************************************************************
 007:0004---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
     DESIGN STANDHYD    02:120        1.44     .163 No_date    2:48   42.78 .533
      [XIMP=.01:TIMP=.20]
      [SLP=2.00:DT= 1.00]
      [LOSS= 2 :CN= 75.0]
#**************************************************************************
#      Mayfield Rd Grass Areas
#**************************************************************************
 007:0005---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
     DESIGN NASHYD      03:130        2.05     .188 No_date    2:52   37.99 .473
      [CN= 75.0: N= 3.00]
      [Tp=  .25:DT= 1.00]
#**************************************************************************
#      Kennedy Road
#**************************************************************************
 007:0006---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
     DESIGN STANDHYD    04:140        1.82     .205 No_date    2:48   42.78 .533
      [XIMP=.01:TIMP=.20]
      [SLP=2.00:DT= 1.00]
      [LOSS= 2 :CN= 75.0]
#**************************************************************************
#      South Kennedy Grass Areas
#**************************************************************************
 007:0007---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
     DESIGN NASHYD      05:150        2.35     .212 No_date    2:52   37.99 .473
      [CN= 75.0: N= 3.00]
      [Tp=  .26:DT= 1.00]
 007:0008---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
     ADD HYD            01:110        2.93     .315 No_date    2:48   41.79  n/a
                      + 02:120        1.44     .163 No_date    2:48   42.78  n/a
                      + 03:130        2.05     .188 No_date    2:52   37.99  n/a
                      + 04:140        1.82     .205 No_date    2:48   42.78  n/a
                      + 05:150        2.35     .212 No_date    2:52   37.99  n/a
       [DT= 1.00]  SUM= 06:pond      10.59    1.074 No_date    2:49   40.52  n/a
 007:0009---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
     PRINT HYD          06:pond      10.59    1.074 No_date    2:49   40.52  n/a
  ** END OF RUN :    7

***************************************************************************



 RUN:COMMAND#
 008:0001-------------------------------------------------------------------
     START
      [TZERO =     .00 hrs on        0]
      [METOUT=   2    (1=imperial, 2=metric output)]
      [NSTORM=   1 ]
      [NRUN   =  8 ]
#**************************************************************************
#  Project Name: [Mayfield Road]     Project Number: [602-10320]
#  Date          : June, 2007
#  Modeller      : [Dan McCreery]
#  Company       : Stantec Consulting Ltd. (Kitchener)
#  License #     :  4730904
#**************************************************************************
#**************************************************************************
 008:0002-------------------------------------------------------------------
     READ STORM
      Filename = Storm.001
      Comment  = REGIONAL STORM
      [SDT=15.00:SDUR=  48.00:PTOT= 285.00]
#**************************************************************************
#      The following info is based on the Storm Drainage Plan
#**************************************************************************
#**************************************************************************
#      Mayfield Rd East of Kennedy Rd.
#**************************************************************************
 008:0003---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
  * DESIGN STANDHYD     01:110        2.93     .401 No_date   46:00  226.98 .796
      [XIMP=.01:TIMP=.16]
      [SLP=2.00:DT= 1.00]
      [LOSS= 2 :CN= 75.0]
#**************************************************************************
#      Mayfield Rd at Kennedy Rd
#**************************************************************************
 008:0004---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
     DESIGN STANDHYD    02:120        1.44     .199 No_date   46:00  229.22 .804
      [XIMP=.01:TIMP=.20]
      [SLP=2.00:DT= 1.00]
      [LOSS= 2 :CN= 75.0]
#**************************************************************************
#      Mayfield Rd Grass Areas
#**************************************************************************
 008:0005---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
     DESIGN NASHYD      03:130        2.05     .275 No_date   46:02  218.30 .766
      [CN= 75.0: N= 3.00]
      [Tp=  .25:DT= 1.00]
#**************************************************************************
#      Kennedy Road
#**************************************************************************
 008:0006---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
     DESIGN STANDHYD    04:140        1.82     .251 No_date   46:00  229.22 .804
      [XIMP=.01:TIMP=.20]
      [SLP=2.00:DT= 1.00]
      [LOSS= 2 :CN= 75.0]
#**************************************************************************
#      South Kennedy Grass Areas
#**************************************************************************
 008:0007---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
     DESIGN NASHYD      05:150        2.35     .315 No_date   46:02  218.30 .766
      [CN= 75.0: N= 3.00]
      [Tp=  .26:DT= 1.00]
 008:0008---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
     ADD HYD            01:110        2.93     .401 No_date   46:00  226.98  n/a
                      + 02:120        1.44     .199 No_date   46:00  229.22  n/a
                      + 03:130        2.05     .275 No_date   46:02  218.30  n/a
                      + 04:140        1.82     .251 No_date   46:00  229.22  n/a
                      + 05:150        2.35     .315 No_date   46:02  218.30  n/a
       [DT= 1.00]  SUM= 06:pond      10.59    1.440 No_date   46:01  224.06  n/a
 008:0009---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
     PRINT HYD          06:pond      10.59    1.440 No_date   46:01  224.06  n/a
 008:0002-------------------------------------------------------------------
     FINISH
----------------------------------------------------------------------------
****************************************************************************
     WARNINGS / ERRORS / NOTES
     -------------------------
 001:0003 DESIGN STANDHYD
      *** WARNING: For areas with impervious ratios below
                   20%, this routine may not be applicable.
      *** WARNING: For areas with impervious ratios below
                   20%, this routine may not be applicable.
      *** WARNING: For areas with impervious ratios below
                   20%, this routine may not be applicable.
      *** WARNING: For areas with impervious ratios below
                   20%, this routine may not be applicable.
      *** WARNING: For areas with impervious ratios below
                   20%, this routine may not be applicable.
      *** WARNING: For areas with impervious ratios below
                   20%, this routine may not be applicable.
      *** WARNING: For areas with impervious ratios below
                   20%, this routine may not be applicable.
      *** WARNING: For areas with impervious ratios below
                   20%, this routine may not be applicable.
   Simulation ended on 2007-07-18      at 14:28:00
----------------------------------------------------------------------------
```

```
        Metric units
*#*****************************************************************************
*#  Project Name: [Mayfield Road]     Project Number: [602-10320]
*#  Date         : June, 2007
*#  Modeller     : [Dan McCreery]
*#  Company      : Stantec Consulting Ltd. (Kitchener)
*#  License #    :  4730904
*#*****************************************************************************
*#*****************************************************************************
START                 TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[1]
*%                     ["25mm4hr.stm"] <--storm filename, one per line for NSTORM
*%-----------------|----------------------------------------------------------|
READ STORM            STORM_FILENAME=["Storm.001"]
*%-----------------|----------------------------------------------------------|
*#*****************************************************************************
*#        The following info is based on the Storm Drainage Plan
*#*****************************************************************************
*#*****************************************************************************
*#        Mayfield Rd East of Kennedy Rd.
*#*****************************************************************************
*%-----------------|----------------------------------------------------------|
DESIGN STANDHYD       ID=[1], NHYD=["110"], DT=[1]min, AREA=[2.93](ha),
                      XIMP=[0.5], TIMP=[0.5], DWF=[0](cms),  LOSS=[2], CN=[75]
                      SLOPE=[2](%), RAINFALL=[ , , , , ](mm/hr), END=-1
*#*****************************************************************************
*#        Mayfield Rd at Kennedy Rd
*#*****************************************************************************
*%-----------------|----------------------------------------------------------|
DESIGN STANDHYD       ID=[2], NHYD=["120"], DT=[1]min, AREA=[1.44](ha),
                      XIMP=[0.88], TIMP=[0.88], DWF=[0](cms),  LOSS=[2], CN=[75]
                      SLOPE=[2](%), RAINFALL=[ , , , , ](mm/hr), END=-1
*#*****************************************************************************
*#        Mayfield Rd Grass Areas
*#*****************************************************************************
*%-----------------|----------------------------------------------------------|
DESIGN NASHYD         ID=[3], NHYD=["130"], DT=[1]min, AREA=[2.05](ha),
                      DWF=[0](cms), CN/C=[77], TP=[0.25]hrs,
                      RAINFALL=[ ,   ,   ,   , ](mm/hr), END=-1
*#*****************************************************************************
*#        Kennedy Road
*#*****************************************************************************
*%-----------------|----------------------------------------------------------|
DESIGN STANDHYD       ID=[4], NHYD=["140"], DT=[1]min, AREA=[1.82](ha),
                      XIMP=[0.75], TIMP=[0.75], DWF=[0](cms),  LOSS=[2], CN=[75]
                      SLOPE=[2](%), RAINFALL=[ , , , , ](mm/hr), END=-1
*#*****************************************************************************
*#        South Kennedy Grass Areas
*#*****************************************************************************
*%-----------------|----------------------------------------------------------|
DESIGN NASHYD         ID=[5], NHYD=["150"], DT=[1]min, AREA=[2.35](ha),
                      DWF=[0](cms), CN/C=[75], TP=[0.26]hrs,
                      RAINFALL=[ ,   ,   ,   , ](mm/hr), END=-1
*%-----------------|----------------------------------------------------------|
ADD HYD               IDsum=[6], NHYD=["pond"], IDs to add=[1+2+3+4+5]
*%-----------------|----------------------------------------------------------|
PRINT HYD             ID=[6],    # OF PCYCLES=[0]
*%-----------------|----------------------------------------------------------|
ROUTE RESERVOIR       IDout=[1],    NHYD=["SWM"],   IDin=[6],
                      RDT=[1](min),
                           TABLE of ( OUTFLOW-STORAGE ) values
                                    (cms) - (ha-m)
                                  [   0.0 ,  0.0  ]
                                  [0.0009, 0.0104]
                                  [0.0043, 0.0211]
                                  [0.006, 0.0321]
                                  [0.0074, 0.0435]
                                  [0.0085, 0.0553]
                                  [0.023, 0.0798]
                                  [0.032, 0.1057]
                                  [0.038, 0.1328]
                                  [0.043, 0.1609]
                                  [0.048, 0.1902]
                                  [0.215, 0.2205]
                                  [0.519, 0.2519]
                                  [2.534, 0.3913]
                                  [  -1  ,  -1  ]  (max twenty pts)
                           IDovf=[   ], NHYDovf=[   ]
*%-----------------|----------------------------------------------------------|
START                 TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[2]
*%                     ["2y6hAES.stm"] <--storm filename, one per line for NSTORM
*%-----------------|----------------------------------------------------------|
START                 TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[3]
*%                     ["5y6hAES.stm"] <--storm filename, one per line for NSTORM
*%-----------------|----------------------------------------------------------|
START                 TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[4]
*%                     ["10y6hAES.stm"] <--storm filename, one per line for NSTORM
*%-----------------|----------------------------------------------------------|
START                 TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[5]
*%                     ["25y6hAES.stm"] <--storm filename, one per line for NSTORM
*%-----------------|----------------------------------------------------------|
START                 TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[6]
*%                     ["50y6hAES.stm"] <--storm filename, one per line for NSTORM
*%-----------------|----------------------------------------------------------|
START                 TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[7]
*%                     ["1006hAES.stm"] <--storm filename, one per line for NSTORM
*%-----------------|----------------------------------------------------------|
START                 TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[8]
*%                     ["hurhaz48.stm"] <--storm filename, one per line for NSTORM
*%-----------------|----------------------------------------------------------|
*%-----------------|----------------------------------------------------------|
FINISH
```

```
=======================================================================

SSSSS  W   W  M   M  H   H  Y   Y  M   M   OOO       999    999  =========
S      W W W  MM MM  H   H   Y Y   MM MM  O   O     9   9  9   9
SSSSS  W W W  M M M  HHHHH    Y    M M M  O   O  ## 9   9  9   9 Ver. 4.02
    S   W W   M   M  H   H    Y    M   M  O   O      9999   9999 July 1999
SSSSS   W W   M   M  H   H    Y    M   M   OOO          9      9 =========
                                                    9   9  9   9 # 4730904
      StormWater Management HYdrologic Model         999    999  =========

***********************************************************************
************************* SWMHYMO-99 Ver/4.02 *************************
*******  A single event and continuous hydrologic simulation model  *******
*******     based on the principles of HYMO and its successors     *******
*******                 OTTHYMO-83 and OTTHYMO-89.                 *******
***********************************************************************
******* Distributed by:  J.F. Sabourin and Associates Inc.          *******
*******                  Ottawa,  Ontario: (613) 727-5199          *******
*******                  Gatineau, Quebec: (819) 243-6858          *******
*******                  E-Mail: swmhymo@jfsa.Com                  *******
***********************************************************************

+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
+++++++ Licensed user: Stantec Consulting Ltd. (kitchener)         +++++++
+++++++                Kitchener              SERIAL#:4730904      +++++++
+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

***********************************************************************
*******             ++++++ PROGRAM ARRAY DIMENSIONS ++++++         *******
*******             Maximum value for ID numbers   :    10         *******
*******             Max. number of rainfall points:  15000         *******
*******             Max. number of flow points    :  15000         *******
***********************************************************************

*** DESCRIPTION SUMMARY TABLE HEADERS (units depend on METOUT in START) ***
***-------------------------------------------------------------------***
***       ID:  Hydrograph IDentification numbers, (1-10).             ***
***     NHYD:  Hydrograph reference numbers, (6 digits or characters). ***
***     AREA:  Drainage area associated with hydrograph, (ac.) or (ha.). ***
***    QPEAK:  Peak flow of simulated hydrograph, (ft^3/s) or (m^3/s). ***
*** TpeakDate_hh:mm is the date and time of the peak flow.            ***
***     R.V.:  Runoff Volume of simulated hydrograph, (in) or (mm).   ***
***     R.C.:  Runoff Coefficient of simulated hydrograph, (ratio).   ***
***        *:  see WARNING or NOTE message printed at end of run.     ***
***       **:  see  ERROR  message printed at end of run.             ***
***********************************************************************

:::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::

***********************************************************************

********************  S U M M A R Y   O U T P U T  ********************
***********************************************************************
*      DATE: 2007-08-03      TIME: 10:01:46      RUN COUNTER: 004075   *
***********************************************************************
* Input   filename: C:\usr\90\ken07.dat                                *
* Output  filename: C:\usr\90\ken07.out                                *
* Summary filename: C:\usr\90\ken07.sum                                *
* User comments:                                                       *
* 1:_____________________________________________________________      *
* 2:_____________________________________________________________      *
* 3:_____________________________________________________________      *
***********************************************************************


#**********************************************************************
#  Project Name: [Mayfield Road]     Project Number: [602-10320]
#  Date         : June, 2007
#  Modeller     : [Dan McCreery]
#  Company      : Stantec Consulting Ltd. (Kitchener)
#  License #    :  4730904
#**********************************************************************
#**********************************************************************
RUN:COMMAND#
001:0001--------------------------------------------------------------
    START
     [TZERO =     .00 hrs on         0]
     [METOUT=   2     (1=imperial, 2=metric output)]
     [NSTORM=   1 ]
     [NRUN  =   1 ]
001:0002--------------------------------------------------------------
    READ STORM
     Filename = Storm.001
     Comment  = Twenty five mm Four Hour Chicago Storm
     [SDT=10.00:SDUR=   4.00:PTOT=  25.00]
#**********************************************************************
#      The following info is based on the Storm Drainage Plan
#**********************************************************************
#**********************************************************************
#      Mayfield Rd East of Kennedy Rd.
#**********************************************************************
001:0003---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
    DESIGN STANDHYD    01:110        2.93     .195 No_date    1:30   14.65 .586
     [XIMP=.50:TIMP=.50]
     [SLP=2.00:DT= 1.00]
     [LOSS= 2 :CN= 75.0]
#**********************************************************************
#      Mayfield Rd at Kennedy Rd
#**********************************************************************
001:0004---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
    DESIGN STANDHYD    02:120        1.44     .172 No_date    1:30   21.91 .876
     [XIMP=.88:TIMP=.88]
     [SLP=2.00:DT= 1.00]
     [LOSS= 2 :CN= 75.0]
#**********************************************************************
#      Mayfield Rd Grass Areas
#**********************************************************************
001:0005---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
    DESIGN NASHYD      03:130        2.05     .026 No_date    1:46    5.56 .222
     [CN= 77.0: N= 3.00]
     [Tp=  .25:DT= 1.00]
#**********************************************************************
#      Kennedy Road
#**********************************************************************
001:0006---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
    DESIGN STANDHYD    04:140        1.82     .184 No_date    1:30   19.42 .777
     [XIMP=.75:TIMP=.75]
     [SLP=2.00:DT= 1.00]
     [LOSS= 2 :CN= 75.0]
#**********************************************************************
#      South Kennedy Grass Areas
#**********************************************************************
001:0007---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
    DESIGN NASHYD      05:150        2.35     .026 No_date    1:47    5.10 .204
     [CN= 75.0: N= 3.00]
     [Tp=  .26:DT= 1.00]
001:0008---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
    ADD HYD            01:110        2.93     .195 No_date    1:30   14.65  n/a
                     + 02:120        1.44     .172 No_date    1:30   21.91  n/a
                     + 03:130        2.05     .026 No_date    1:46    5.56  n/a
                     + 04:140        1.82     .184 No_date    1:30   19.42  n/a
                     + 05:150        2.35     .026 No_date    1:47    5.10  n/a
     [DT= 1.00]  SUM=  06:pond      10.59     .569 No_date    1:30   12.58  n/a
001:0009---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
    PRINT HYD          06:pond      10.59     .569 No_date    1:30   12.58  n/a
001:0010---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
    ROUTE RESERVOIR -> 06:pond      10.59     .569 No_date    1:30   12.58  n/a
     [RDT= 1.00] out<- 01:SWM       10.59     .032 No_date    4:03   12.58  n/a
    [MxStoUsed=.1058E+00]
 ** END OF RUN :   1

***********************************************************************


RUN:COMMAND#
002:0001--------------------------------------------------------------
    START
     [TZERO =     .00 hrs on         0]
     [METOUT=   2     (1=imperial, 2=metric output)]
     [NSTORM=   1 ]
     [NRUN  =   2 ]
#**********************************************************************
#  Project Name: [Mayfield Road]     Project Number: [602-10320]
#  Date         : June, 2007
#  Modeller     : [Dan McCreery]
#  Company      : Stantec Consulting Ltd. (Kitchener)
#  License #    :  4730904
#**********************************************************************
002:0002--------------------------------------------------------------
    READ STORM
     Filename = Storm.001
     Comment  = 2yr/6hr
     [SDT=15.00:SDUR=   6.25:PTOT=  36.00]
#**********************************************************************
#      The following info is based on the Storm Drainage Plan
#**********************************************************************
#**********************************************************************
#      Mayfield Rd East of Kennedy Rd.
#**********************************************************************
002:0003---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
    DESIGN STANDHYD    01:110        2.93     .157 No_date    2:45   22.59 .628
     [XIMP=.50:TIMP=.50]
     [SLP=2.00:DT= 1.00]
     [LOSS= 2 :CN= 75.0]
#**********************************************************************
#      Mayfield Rd at Kennedy Rd
#**********************************************************************
002:0004---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
    DESIGN STANDHYD    02:120        1.44     .119 No_date    2:45   32.17 .894
     [XIMP=.88:TIMP=.88]
     [SLP=2.00:DT= 1.00]
     [LOSS= 2 :CN= 75.0]
#**********************************************************************
#      Mayfield Rd Grass Areas
#**********************************************************************
002:0005---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
    DESIGN NASHYD      03:130        2.05     .052 No_date    2:52   10.78 .300
     [CN= 77.0: N= 3.00]
     [Tp=  .25:DT= 1.00]
#**********************************************************************
#      Kennedy Road
#**********************************************************************
002:0006---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
    DESIGN STANDHYD    04:140        1.82     .132 No_date    2:45   28.90 .803
     [XIMP=.75:TIMP=.75]
     [SLP=2.00:DT= 1.00]
     [LOSS= 2 :CN= 75.0]
#**********************************************************************
#      South Kennedy Grass Areas
#**********************************************************************
002:0007---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
    DESIGN NASHYD      05:150        2.35     .054 No_date    2:53    9.99 .277
     [CN= 75.0: N= 3.00]
     [Tp=  .26:DT= 1.00]
002:0008---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
    ADD HYD            01:110        2.93     .157 No_date    2:45   22.59  n/a
                     + 02:120        1.44     .119 No_date    2:45   32.17  n/a
                     + 03:130        2.05     .052 No_date    2:52   10.78  n/a
                     + 04:140        1.82     .132 No_date    2:45   28.90  n/a
                     + 05:150        2.35     .054 No_date    2:53    9.99  n/a
     [DT= 1.00]  SUM=  06:pond      10.59     .500 No_date    2:45   19.90  n/a
002:0009---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
    PRINT HYD          06:pond      10.59     .500 No_date    2:45   19.90  n/a
002:0010---------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
    ROUTE RESERVOIR -> 06:pond      10.59     .500 No_date    2:45   19.90  n/a
     [RDT= 1.00] out<- 01:SWM       10.59     .044 No_date    4:26   19.90  n/a
    [MxStoUsed=.1676E+00]
 ** END OF RUN :   2

***********************************************************************


RUN:COMMAND#
003:0001--------------------------------------------------------------
    START
     [TZERO =     .00 hrs on         0]
     [METOUT=   2     (1=imperial, 2=metric output)]
     [NSTORM=   1 ]
     [NRUN  =   3 ]
#**********************************************************************
#  Project Name: [Mayfield Road]     Project Number: [602-10320]
#  Date         : June, 2007
```

```
#  Modeller    : [Dan McCreery]
#  Company     : Stantec Consulting Ltd. (Kitchener)
#  License #   : 4730904
#**********************************************************************
#**********************************************************************
 003:0002----------------------------------------------------------
     READ STORM
       Filename = Storm.001
       Comment  = 5yr/6hr
       [SDT=15.00:SDUR=   6.25:PTOT=  47.81]
#**********************************************************************
#    The following info is based on the Storm Drainage Plan
#**********************************************************************
#**********************************************************************
#    Mayfield Rd East of Kennedy Rd.
#**********************************************************************
 003:0003--------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
     DESIGN STANDHYD    01:110        2.93     .224 No_date    2:45   31.69 .663
       [XIMP=.50:TIMP=.50]
       [SLP=2.00:DT= 1.00]
       [LOSS= 2 :CN= 75.0]
#**********************************************************************
#    Mayfield Rd at Kennedy Rd
#**********************************************************************
 003:0004--------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
     DESIGN STANDHYD    02:120        1.44     .160 No_date    2:45   43.33 .906
       [XIMP=.88:TIMP=.88]
       [SLP=2.00:DT= 1.00]
       [LOSS= 2 :CN= 75.0]
#**********************************************************************
#    Mayfield Rd Grass Areas
#**********************************************************************
 003:0005--------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
     DESIGN NASHYD      03:130        2.05     .086 No_date    2:52   17.55 .367
       [CN= 77.0: N= 3.00]
       [Tp=  .25:DT= 1.00]
#**********************************************************************
#    Kennedy Road
#**********************************************************************
 003:0006--------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
     DESIGN STANDHYD    04:140        1.82     .181 No_date    2:45   39.35 .823
       [XIMP=.75:TIMP=.75]
       [SLP=2.00:DT= 1.00]
       [LOSS= 2 :CN= 75.0]
#**********************************************************************
#    South Kennedy Grass Areas
#**********************************************************************
 003:0007--------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
     DESIGN NASHYD      05:150        2.35     .090 No_date    2:53   16.37 .342
       [CN= 75.0: N= 3.00]
       [Tp=  .26:DT= 1.00]
 003:0008--------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
     ADD HYD            01:110        2.93     .224 No_date    2:45   31.69  n/a
                      + 02:120        1.44     .160 No_date    2:45   43.33  n/a
                      + 03:130        2.05     .086 No_date    2:52   17.55  n/a
                      + 04:140        1.82     .181 No_date    2:45   39.35  n/a
                      + 05:150        2.35     .090 No_date    2:53   16.37  n/a
       [DT= 1.00]  SUM= 06:pond      10.59     .719 No_date    2:45   28.46  n/a
 003:0009--------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
     PRINT HYD          06:pond      10.59     .719 No_date    2:45   28.46  n/a
 003:0010--------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
     ROUTE RESERVOIR -> 06:pond      10.59     .719 No_date    2:45   28.46  n/a
       [RDT= 1.00] out<- 01:SWM      10.59     .166 No_date    3:41   28.45  n/a
       [MxStoUsed=.2117E+00]
  ** END OF RUN :    3

**********************************************************************


 RUN:COMMAND#
 004:0001----------------------------------------------------------
     START
       [TZERO =     .00 hrs on          0]
       [METOUT=   2    (1=imperial, 2=metric output)]
       [NSTORM=   1 ]
       [NRUN  =   4 ]
#**********************************************************************
#  Project Name: [Mayfield Road]     Project Number: [602-10320]
#  Date        : June, 2007
#  Modeller    : [Dan McCreery]
#  Company     : Stantec Consulting Ltd. (Kitchener)
#  License #   : 4730904
#**********************************************************************
#**********************************************************************
 004:0002----------------------------------------------------------
     READ STORM
       Filename = Storm.001
       Comment  = 10yr/6hr
       [SDT=15.00:SDUR=   6.25:PTOT=  55.69]
#**********************************************************************
#    The following info is based on the Storm Drainage Plan
#**********************************************************************
#**********************************************************************
#    Mayfield Rd East of Kennedy Rd.
#**********************************************************************
 004:0003--------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
     DESIGN STANDHYD    01:110        2.93     .271 No_date    2:45   38.02 .683
       [XIMP=.50:TIMP=.50]
       [SLP=2.00:DT= 1.00]
       [LOSS= 2 :CN= 75.0]
#**********************************************************************
#    Mayfield Rd at Kennedy Rd
#**********************************************************************
 004:0004--------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
     DESIGN STANDHYD    02:120        1.44     .188 No_date    2:45   50.84 .913
       [XIMP=.88:TIMP=.88]
       [SLP=2.00:DT= 1.00]
       [LOSS= 2 :CN= 75.0]
#**********************************************************************
#    Mayfield Rd Grass Areas
#**********************************************************************
 004:0005--------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
     DESIGN NASHYD      03:130        2.05     .111 No_date    2:52   22.58 .405
       [CN= 77.0: N= 3.00]
       [Tp=  .25:DT= 1.00]
#**********************************************************************
#    Kennedy Road
#**********************************************************************
 004:0006--------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
     DESIGN STANDHYD    04:140        1.82     .214 No_date    2:45   46.45 .834
       [XIMP=.75:TIMP=.75]
       [SLP=2.00:DT= 1.00]
       [LOSS= 2 :CN= 75.0]
#**********************************************************************
#    South Kennedy Grass Areas
#**********************************************************************
 004:0007--------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
     DESIGN NASHYD      05:150        2.35     .116 No_date    2:52   21.15 .380
       [CN= 75.0: N= 3.00]
       [Tp=  .26:DT= 1.00]
 004:0008--------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
     ADD HYD            01:110        2.93     .271 No_date    2:45   38.02  n/a
                      + 02:120        1.44     .188 No_date    2:45   50.84  n/a
                      + 03:130        2.05     .111 No_date    2:52   22.58  n/a
                      + 04:140        1.82     .214 No_date    2:45   46.45  n/a
                      + 05:150        2.35     .116 No_date    2:52   21.15  n/a
       [DT= 1.00]  SUM= 06:pond      10.59     .874 No_date    2:45   34.48  n/a
 004:0009--------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
     PRINT HYD          06:pond      10.59     .874 No_date    2:45   34.48  n/a
 004:0010--------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
     ROUTE RESERVOIR -> 06:pond      10.59     .874 No_date    2:45   34.48  n/a
       [RDT= 1.00] out<- 01:SWM      10.59     .303 No_date    3:19   34.48  n/a
       [MxStoUsed=.2296E+00]
  ** END OF RUN :    4

**********************************************************************


 RUN:COMMAND#
 005:0001----------------------------------------------------------
     START
       [TZERO =     .00 hrs on          0]
       [METOUT=   2    (1=imperial, 2=metric output)]
       [NSTORM=   1 ]
       [NRUN  =   5 ]
#**********************************************************************
#  Project Name: [Mayfield Road]     Project Number: [602-10320]
#  Date        : June, 2007
#  Modeller    : [Dan McCreery]
#  Company     : Stantec Consulting Ltd. (Kitchener)
#  License #   : 4730904
#**********************************************************************
#**********************************************************************
 005:0002----------------------------------------------------------
     READ STORM
       Filename = Storm.001
       Comment  = 25yr/6hr
       [SDT=15.00:SDUR=   6.25:PTOT=  65.59]
#**********************************************************************
#    The following info is based on the Storm Drainage Plan
#**********************************************************************
#**********************************************************************
#    Mayfield Rd East of Kennedy Rd.
#**********************************************************************
 005:0003--------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
     DESIGN STANDHYD    01:110        2.93     .335 No_date    2:45   46.20 .704
       [XIMP=.50:TIMP=.50]
       [SLP=2.00:DT= 1.00]
       [LOSS= 2 :CN= 75.0]
#**********************************************************************
#    Mayfield Rd at Kennedy Rd
#**********************************************************************
 005:0004--------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
     DESIGN STANDHYD    02:120        1.44     .223 No_date    2:45   60.33 .920
       [XIMP=.88:TIMP=.88]
       [SLP=2.00:DT= 1.00]
       [LOSS= 2 :CN= 75.0]
#**********************************************************************
#    Mayfield Rd Grass Areas
#**********************************************************************
 005:0005--------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
     DESIGN NASHYD      03:130        2.05     .145 No_date    2:52   29.35 .447
       [CN= 77.0: N= 3.00]
       [Tp=  .25:DT= 1.00]
#**********************************************************************
#    Kennedy Road
#**********************************************************************
 005:0006--------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
     DESIGN STANDHYD    04:140        1.82     .257 No_date    2:45   55.50 .846
       [XIMP=.75:TIMP=.75]
       [SLP=2.00:DT= 1.00]
       [LOSS= 2 :CN= 75.0]
#**********************************************************************
#    South Kennedy Grass Areas
#**********************************************************************
 005:0007--------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
     DESIGN NASHYD      05:150        2.35     .153 No_date    2:52   27.61 .421
       [CN= 75.0: N= 3.00]
       [Tp=  .26:DT= 1.00]
 005:0008--------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
     ADD HYD            01:110        2.93     .335 No_date    2:45   46.20  n/a
                      + 02:120        1.44     .223 No_date    2:45   60.33  n/a
                      + 03:130        2.05     .145 No_date    2:52   29.35  n/a
                      + 04:140        1.82     .257 No_date    2:45   55.50  n/a
                      + 05:150        2.35     .153 No_date    2:52   27.61  n/a
       [DT= 1.00]  SUM= 06:pond      10.59    1.080 No_date    2:45   42.33  n/a
 005:0009--------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
     PRINT HYD          06:pond      10.59    1.080 No_date    2:45   42.33  n/a
 005:0010--------------ID:NHYD-------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
     ROUTE RESERVOIR -> 06:pond      10.59    1.080 No_date    2:45   42.33  n/a
       [RDT= 1.00] out<- 01:SWM      10.59     .476 No_date    3:12   42.33  n/a
       [MxStoUsed=.2475E+00]
  ** END OF RUN :    5

**********************************************************************


 RUN:COMMAND#
 006:0001----------------------------------------------------------
     START
       [TZERO =     .00 hrs on          0]
```

```
      [METOUT=   2    (1=imperial, 2=metric output)]
      [NSTORM=   1 ]
      [NRUN  =   6 ]
#*****************************************************************************
#  Project Name: [Mayfield Road]     Project Number: [602-10320]
#  Date        : June, 2007
#  Modeller    : [Dan McCreery]
#  Company     : Stantec Consulting Ltd. (Kitchener)
#  License #   :  4730904
#*****************************************************************************
#*****************************************************************************
 006:0002-----------------------------------------------------------------------
     READ STORM
      Filename = Storm.001
      Comment  = 50yr/6hr
      [SDT=15.00:SDUR=   6.25:PTOT=  73.00]
#*****************************************************************************
#       The following info is based on the Storm Drainage Plan
#*****************************************************************************
#*****************************************************************************
#       Mayfield Rd East of Kennedy Rd.
#*****************************************************************************
 006:0003----------------ID:NHYD--------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
     DESIGN STANDHYD      01:110          2.93      .385 No_date    2:45   52.47 .719
      [XIMP=.50:TIMP=.50]
      [SLP=2.00:DT= 1.00]
      [LOSS= 2 :CN= 75.0]
#*****************************************************************************
#       Mayfield Rd at Kennedy Rd
#*****************************************************************************
 006:0004----------------ID:NHYD--------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
     DESIGN STANDHYD      02:120          1.44      .250 No_date    2:45   67.46 .924
      [XIMP=.88:TIMP=.88]
      [SLP=2.00:DT= 1.00]
      [LOSS= 2 :CN= 75.0]
#*****************************************************************************
#       Mayfield Rd Grass Areas
#*****************************************************************************
 006:0005----------------ID:NHYD--------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
     DESIGN NASHYD        03:130          2.05      .172 No_date    2:52   34.69 .475
      [CN= 77.0: N= 3.00]
      [Tp=  .25:DT= 1.00]
#*****************************************************************************
#       Kennedy Road
#*****************************************************************************
 006:0006----------------ID:NHYD--------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
     DESIGN STANDHYD      04:140          1.82      .290 No_date    2:45   62.33 .854
      [XIMP=.75:TIMP=.75]
      [SLP=2.00:DT= 1.00]
      [LOSS= 2 :CN= 75.0]
#*****************************************************************************
#       South Kennedy Grass Areas
#*****************************************************************************
 006:0007----------------ID:NHYD--------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
     DESIGN NASHYD        05:150          2.35      .182 No_date    2:52   32.74 .448
      [CN= 75.0: N= 3.00]
      [Tp=  .26:DT= 1.00]
 006:0008----------------ID:NHYD--------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
     ADD HYD              01:110          2.93      .385 No_date    2:45   52.47  n/a
                        + 02:120          1.44      .250 No_date    2:45   67.46  n/a
                        + 03:130          2.05      .172 No_date    2:52   34.69  n/a
                        + 04:140          1.82      .290 No_date    2:45   62.33  n/a
                        + 05:150          2.35      .182 No_date    2:52   32.74  n/a
      [DT= 1.00]  SUM=    06:pond        10.59     1.240 No_date    2:45   48.38  n/a
 006:0009----------------ID:NHYD--------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
     PRINT HYD            06:pond        10.59     1.240 No_date    2:45   48.38  n/a
 006:0010----------------ID:NHYD--------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
     ROUTE RESERVOIR ->   06:pond        10.59     1.240 No_date    2:45   48.38  n/a
      [RDT= 1.00] out<-   01:SWM         10.59      .634 No_date    3:03   48.38  n/a
      [MxStoUsed=.2598E+00]
  ** END OF RUN :    6

*******************************************************************************



 RUN:COMMAND#
 007:0001-----------------------------------------------------------------------
     START
      [TZERO =     .00 hrs on        0]
      [METOUT=   2    (1=imperial, 2=metric output)]
      [NSTORM=   1 ]
      [NRUN  =   7 ]
#*****************************************************************************
#  Project Name: [Mayfield Road]     Project Number: [602-10320]
#  Date        : June, 2007
#  Modeller    : [Dan McCreery]
#  Company     : Stantec Consulting Ltd. (Kitchener)
#  License #   :  4730904
#*****************************************************************************
#*****************************************************************************
 007:0002-----------------------------------------------------------------------
     READ STORM
      Filename = Storm.001
      Comment  = 100yr/6hr
      [SDT=15.00:SDUR=   6.25:PTOT=  80.31]
#*****************************************************************************
#       The following info is based on the Storm Drainage Plan
#*****************************************************************************
#*****************************************************************************
#       Mayfield Rd East of Kennedy Rd.
#*****************************************************************************
 007:0003----------------ID:NHYD--------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
     DESIGN STANDHYD      01:110          2.93      .433 No_date    2:45   58.75 .732
      [XIMP=.50:TIMP=.50]
      [SLP=2.00:DT= 1.00]
      [LOSS= 2 :CN= 75.0]
#*****************************************************************************
#       Mayfield Rd at Kennedy Rd
#*****************************************************************************
 007:0004----------------ID:NHYD--------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
     DESIGN STANDHYD      02:120          1.44      .276 No_date    2:45   74.53 .928
      [XIMP=.88:TIMP=.88]
      [SLP=2.00:DT= 1.00]
      [LOSS= 2 :CN= 75.0]
#*****************************************************************************
#       Mayfield Rd Grass Areas
#*****************************************************************************
 007:0005----------------ID:NHYD--------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
     DESIGN NASHYD        03:130          2.05      .200 No_date    2:51   40.15 .500
      [CN= 77.0: N= 3.00]
      [Tp=  .25:DT= 1.00]
#*****************************************************************************
#       Kennedy Road
#*****************************************************************************
 007:0006----------------ID:NHYD--------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
     DESIGN STANDHYD      04:140          1.82      .322 No_date    2:45   69.13 .861
      [XIMP=.75:TIMP=.75]
      [SLP=2.00:DT= 1.00]
      [LOSS= 2 :CN= 75.0]
#*****************************************************************************
#       South Kennedy Grass Areas
#*****************************************************************************
 007:0007----------------ID:NHYD--------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
     DESIGN NASHYD        05:150          2.35      .212 No_date    2:52   37.99 .473
      [CN= 75.0: N= 3.00]
      [Tp=  .26:DT= 1.00]
 007:0008----------------ID:NHYD--------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
     ADD HYD              01:110          2.93      .433 No_date    2:45   58.75  n/a
                        + 02:120          1.44      .276 No_date    2:45   74.53  n/a
                        + 03:130          2.05      .200 No_date    2:51   40.15  n/a
                        + 04:140          1.82      .322 No_date    2:45   69.13  n/a
                        + 05:150          2.35      .212 No_date    2:52   37.99  n/a
      [DT= 1.00]  SUM=    06:pond        10.59     1.401 No_date    2:45   54.47  n/a
 007:0009----------------ID:NHYD--------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
     PRINT HYD            06:pond        10.59     1.401 No_date    2:45   54.47  n/a
 007:0010----------------ID:NHYD--------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
     ROUTE RESERVOIR ->   06:pond        10.59     1.401 No_date    2:45   54.47  n/a
      [RDT= 1.00] out<-   01:SWM         10.59      .802 No_date    2:56   54.47  n/a
      [MxStoUsed=.2715E+00]
  ** END OF RUN :    7

*******************************************************************************



 RUN:COMMAND#
 008:0001-----------------------------------------------------------------------
     START
      [TZERO =     .00 hrs on        0]
      [METOUT=   2    (1=imperial, 2=metric output)]
      [NSTORM=   1 ]
      [NRUN  =   8 ]
#*****************************************************************************
#  Project Name: [Mayfield Road]     Project Number: [602-10320]
#  Date        : June, 2007
#  Modeller    : [Dan McCreery]
#  Company     : Stantec Consulting Ltd. (Kitchener)
#  License #   :  4730904
#*****************************************************************************
#*****************************************************************************
 008:0002-----------------------------------------------------------------------
     READ STORM
      Filename = Storm.001
      Comment  = REGIONAL STORM
      [SDT=15.00:SDUR=  48.00:PTOT= 285.00]
#*****************************************************************************
#       The following info is based on the Storm Drainage Plan
#*****************************************************************************
#*****************************************************************************
#       Mayfield Rd East of Kennedy Rd.
#*****************************************************************************
 008:0003----------------ID:NHYD--------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
     DESIGN STANDHYD      01:110          2.93      .412 No_date   46:00  251.25 .882
      [XIMP=.50:TIMP=.50]
      [SLP=2.00:DT= 1.00]
      [LOSS= 2 :CN= 75.0]
#*****************************************************************************
#       Mayfield Rd at Kennedy Rd
#*****************************************************************************
 008:0004----------------ID:NHYD--------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
     DESIGN STANDHYD      02:120          1.44      .210 No_date   46:00  276.29 .969
      [XIMP=.88:TIMP=.88]
      [SLP=2.00:DT= 1.00]
      [LOSS= 2 :CN= 75.0]
#*****************************************************************************
#       Mayfield Rd Grass Areas
#*****************************************************************************
 008:0005----------------ID:NHYD--------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
     DESIGN NASHYD        03:130          2.05      .279 No_date   46:02  223.65 .785
      [CN= 77.0: N= 3.00]
      [Tp=  .25:DT= 1.00]
#*****************************************************************************
#       Kennedy Road
#*****************************************************************************
 008:0006----------------ID:NHYD--------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
     DESIGN STANDHYD      04:140          1.82      .262 No_date   46:00  267.73 .939
      [XIMP=.75:TIMP=.75]
      [SLP=2.00:DT= 1.00]
      [LOSS= 2 :CN= 75.0]
#*****************************************************************************
#       South Kennedy Grass Areas
#*****************************************************************************
 008:0007----------------ID:NHYD--------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
     DESIGN NASHYD        05:150          2.35      .315 No_date   46:02  218.30 .766
      [CN= 75.0: N= 3.00]
      [Tp=  .26:DT= 1.00]
 008:0008----------------ID:NHYD--------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
     ADD HYD              01:110          2.93      .412 No_date   46:00  251.25  n/a
                        + 02:120          1.44      .210 No_date   46:00  276.29  n/a
                        + 03:130          2.05      .279 No_date   46:02  223.65  n/a
                        + 04:140          1.82      .262 No_date   46:00  267.73  n/a
                        + 05:150          2.35      .315 No_date   46:02  218.30  n/a
      [DT= 1.00]  SUM=    06:pond        10.59     1.476 No_date   46:00  244.83  n/a
 008:0009----------------ID:NHYD--------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
     PRINT HYD            06:pond        10.59     1.476 No_date   46:00  244.83  n/a
 008:0010----------------ID:NHYD--------AREA----QPEAK-TpeakDate_hh:mm----R.V.-R.C.
     ROUTE RESERVOIR ->   06:pond        10.59     1.476 No_date   46:00  244.83  n/a
      [RDT= 1.00] out<-   01:SWM         10.59     1.431 No_date   46:02  244.82  n/a
      [MxStoUsed=.3150E+00]
 008:0002-----------------------------------------------------------------------
      FINISH
-------------------------------------------------------------------------------
*******************************************************************************
      WARNINGS / ERRORS / NOTES
      -------------------------
```

APPENDIX B

DESIGN CALCULATIONS

602-10320 Mayfield Road at Kennedy SWM

Sediment Forebay Sizing Calculations

Using MOE - SWMPD Manual Criteria (2003)

STORMWATER MANAGEMENT FACILITY

Settling

Dist = $\mathrm{sqrt}(r^*Q_p/v_s)$

= 7.4 m

r : 1 = l to w ratio

Q_p = peak SWM outflow for water quality portion of E.D. zone

v_s = settling velocity for 0.15 mm particles (m/s)

r = 2.22

Q_p = 0.0074

v_s = 0.0003

Dispersion Length

Dist = 8Q/dv

= 14.0 m

Q = 10 yr max inlet flow (m^3/s)

d = depth of perm pool in forebay (m)

v_f = desired vel in forebay (m/s)

Q = 0.874

d = 1

v_f = 0.5

Velocity

v = Q/A

= 0.05 m/s

y = total depth of forebay from perm. pool (m)

b = bottom width (avg) of forebay (m)

Q = 10 yr inlet flow (m^3/s)

A = cross-sectional area (m^2)

Target velocity = 0.15

y = 1

b = 10

Q = 0.874

A = 17

V_{targ} = 0.15

Therefore, **Velocity Target Satisfied**

Cleanout Frequency

Table 6.3 MOE SWMPD Guidelines

cleanout = Vol/(load*A_{sew}*effic)

= 8.3 years

A_{sew} = Contributing Sewer Area (ha)

imp = Percent Impervious (%)

load = Sediment Loading (m^3/ha)

effic = Removal Efficiency (%)

Targ = Cleanout Frequency Target (years)

Vol = Sediment volume (m^3) (0.5m depth)

A_{sew} = 10.59

imp = 41%

load = 1.0

effic = 80%

Targ = 7

Vol = 70

Surface Area Check

SA_f/SA_{pp} = 27.8%

SA_f = Forebay Surface Area (m^2)

SA_{pp} = Total Permanent Pool Surface Area (m^2)

Targ = Forebay size (as % of Permanent Pool Area)

SA_f = 549

SA_{pp} = 1,972

Targ = 25%

Notes

1. Total depth and cross-sectional area are 'worst-case' values, representative of conditions just prior to sediment clean-out
2. Interpolated based on percent impervious
3. Volume of bottom 0.5 m depth, the maximum sediment accumulation depth

602-10320 Mayfield Road at Kennedy
Water Balance and Infiltration Calculations

Existing Drainage Conditions

Topography
Rolling to Hilly (~2%)
Cover
Moderately Rooted Crops
Soils
Clayey Silt Till

Surface Water Regime

The soils are:	Clayey Silt Till	159 mm/yr Infiltration Rate - Pervious Areas (1)
Land cover:	Moderately Rooted Crops	543 mm/yr Evapotranspiration Rate - Pervious Areas (3)
Open water:		650 mm/yr Pan Evaporation Rate for Open Water Areas (4)

Area with:	Sandy Soil (ha)	10.59	Impervious 11%		Open Water (ha)	0
	Total (ha)	10.59	Impervious 11%		Open Water (ha)	0

	Clayey Silt Till	
Precipitation	940 mm/yr (2)	
Evapotranspiration	483 mm/yr (3)	(ET*(1-%IMP))
Infiltration	141 mm/yr (1)	(INFIL*(1-%IMP))
Evaporation (Open Water)	0 mm/yr (4)	
Runoff	315 mm/yr	(= Precipitation - Evaporation - Infiltration - Evaporation)

	Total	Total
Precipitation	99,546 m^3/yr	940.0 mm/yr
Total Evapotranspiration (existing)	51,178 m^3/yr	483.3 mm/yr
Total Existing Infiltration	14,967 m^3/yr	141.3 mm/yr
Total Evaporation (existing)	0 m^3/yr	0.0 mm/yr
Total Runoff (existing)	33,401 m^3/yr	315.4 mm/yr

Proposed Drainage Conditions

Topography
Rolling to Hilly (~2%)
Cover
Urban Lawns
Soils
Clayey Silt Till

Surface Water Regime

The soils are:	Clayey Silt Till	164 mm/yr Infiltration Rate - Pervious Areas (1)
Land cover:	Urban Lawns	531 mm/yr Evapotranspiration Rate - Pervious Areas (3)
Open water:		650 mm/yr Pan Evaporation Rate for Open Water Areas (4)

Area with:	Sandy Silt Till (ha)	10.59	Impervious	41%	Open Water (ha)	0.2
	Total (ha)	10.59	Impervious	41%	Open Water (ha)	0.2

	Clayey Silt Till		
Precipitation	940	mm/yr (2)	
Evapotranspiration	307	mm/yr (3)	(ET*(1-%IMP))
Infiltration	95	mm/yr (5)	(INFIL*(1-%IMP))
Evaporation	12	mm/yr (4)	
Runoff	526	mm/yr	(= Precipitation - Evaporation - Infiltration - Evaporation)

Precipitation	99,546 m^3/yr	940.0 mm/yr
Total Evapotranspiration (post)	32,551 m^3/yr	307.4 mm/yr
Total Infiltration (post)	10,029 m^3/yr	94.7 mm/yr
Total Evaporation (post)	1,300 m^3/yr	12.3 mm/yr
Total Runoff (post)	55,666 m^3/yr	525.6 mm/yr

Infiltration Post Development is	10,029 m^3/yr	94.7 mm/yr
Total Infiltration Deficit:	-4,938 m^3/yr	-47 mm/yr
Total Runoff Surplus:	22,266 m^3/yr	210.3 mm/yr

(1) Infiltration rate based on MOE SWMPP Manual (2003), Table 3.1 Hydrologic Cycle Components, prorated to local precipitation
(2) Precipitation based on average annual precipitation for Toronto, Ontario
(3) Evapotranspiration values based on MOE SWMPP Manual (2003), Table 3.1 Hydrologic Cycle Components, prorated to local precipitation
(4) Open water evaporation (650 mm/yr) based on Environment Canada Calculated Lake Evaporation Data, 1951-1980 (Ontario Climate Centre)
(5) Post development infiltration estimate based MOE SWMPP Manual (2003) - Table 3.1, prorated to local precipitation and imperviousness

LOCATION				DESIGN PARAMETERS
Stantec	**Mayfeld Road—Inder Heights Dr. to Heart Lake Rd.**	**STORM SEWER** Region of Peel / City of Brampton	DESIGN STORM : 1 in 10 Years	
	DATE: January 18, 2008	**DESIGN SHEET**	$R = A (T)^B$	Interpolation Equation
	DESIGNED BY: MG	Job Number: **602 10320**	A = 35.1	MANNING'S n = 0.013 / 51.300
	CHECKED BY: ASL		B = -0.695	MINIMUM COVER: 1.200 m / -0.686
				TIME OF ENTRY 15 min.

LOCATION		FROM M.H.	TO M.H.	DRAINAGE AREA: AREA (ha)	C	A x C (ha)	ACCUM. AREA (ha)	T of C (min)	I (mm/h)	Q (m^3/s)	PIPE SELECTION: LENGTH (m)	PIPE SIZE (mm)	SLOPE (%)	CAP. (FULL) (m^3/s)	Q/Qa CAP. (%)	VEL. (FULL) (m/S)	VEL. (ACT) (m/S)	MANHOLE TIME OF FLOW (min)
DRAINAGE AREA 1																		
Mayfield Road— Inder Heights Drive Catchment																		
11+175		45	44	0.140	0.90	0.126	0.126	15.000	91.990	0.032	50.0	300	1.50	0.118	27.185	1.675	1.374	0.607
11+125		44	43	0.100	0.90	0.090	0.216	15.607	89.490	0.054	45.0	300	3.00	0.167	32.058	2.370	2.097	0.358
				0.190	0.25	0.048												
11+080		43	42	0.100	0.90	0.090	0.354	15.964	88.092	0.087	43.0	375	0.80	0.157	55.160	1.420	1.448	0.495
							0.354	16.459										
				0.470	0.25	0.118												
11+041		42L1	42	0.590	0.90	0.531	0.649	15.000	91.990	0.166	16.0	300	4.00	0.193	85.681	2.736	3.092	0.086
							0.649	15.086										
				0.150	0.35	0.053												
11+037		42	41	0.100	0.90	0.090	1.145	16.459	86.242	0.274	39.0	450	1.70	0.372	73.757	2.337	2.571	0.253
				0.080	0.35	0.028												
10+997		41	40 R	0.070	0.90	0.063	1.236	16.712	85.334	0.293	16.0	450	2.25	0.428	68.480	2.689	2.918	0.091
							1.236	16.803										
10+987		CSP INLET	40R	8.150	0.25	2.038	2.038	27.000	61.140	0.346	22.0	600	1.14	0.656	52.783	2.319	2.342	0.157
						600 CSP TC=[illegible]27.256					600 CSP N=0.024 Q=0.355							
												EXISTING						
10+983		40 R	40 (EX)	0.350	0.70	0.245	3.518	27.256	60.740	0.594	31.0	525	3.00	0.745	79.685	3.441	3.837	0.135
10+950		40 (EX)					3.518	27.391										
DRAINAGE AREA 2																		
Mayfield Road - East Catchment																		
				0.20	0.25	0.050												
12+000		61	60	0.30	0.90	0.270	0.320	15.000	91.990	0.082	57.0	300	1.50	0.118	69.042	1.675	1.82	0.52
				0.04	0.25	0.010												
11+943		60	59	0.28	0.90	0.252	0.582	15.523	89.826	0.145	58.0	375	2.00	0.248	58.567	2.245	2.33	0.41
11+885		59	58	0.29	0.90	0.261	0.843	15.937	88.198	0.207	50.0	375	3.20	0.314	65.849	2.840	3.04	0.27
11+835		58	57	0.25	0.90	0.225	1.068	16.211	87.158	0.259	50.0	450	1.10	0.299	86.471	1.880	2.13	0.39
11+785		57	56	0.25	0.90	0.225	1.293	16.601	85.728	0.308	50.0	450	2.50	0.451	68.303	2.834	3.08	0.27
11+735		56	55	0.25	0.90	0.225	1.518	16.872	84.769	0.357	50.0	450	2.50	0.451	79.292	2.834	3.16	0.26
				0.07	0.25	0.018												
11+685		55	54	0.25	0.90	0.225	1.761	17.136	83.860	0.410	50.0	525	1.50	0.527	77.859	2.433	2.70	0.31
11+635		54	53	0.25	0.90	0.225	1.986	17.445	82.826	0.457	50.0	600	0.75	0.532	85.907	1.881	2.13	0.39
				0.15	0.25	0.038												
11+585		53	52	0.25	0.90	0.225	2.248	17.837	81.557	0.509	42.0	675	0.50	0.594	85.681	1.661	1.88	0.37
				0.10	0.25	0.025												
11+540		52	51	0.20	0.90	0.180	2.453	18.210	80.392	0.548	39.0	675	0.50	0.594	92.159	1.661	1.91	0.34
11+508		51	51L	0.18	0.90	0.162	2.615	18.550	79.364	0.576	23.0	750	0.40	0.704	81.877	1.594	1.79	0.21
11+495		51L	HW	0.00	0.90	0.000	6.130	29.094	58.047	0.988	5.0	900	0.40	1.145	86.322	1.800	2.04	0.04
11+474		HW					6.130	29.135										
Mayfield Road - West Catchment																		
						0.911												
						1.965												
				0.250	0.900	0.225												
11+420		HW	50	0.030	0.900	0.027	3.128	28.133	59.418	0.516	46.0	825	0.16	0.574	89.902	1.074	1.224	0.626
11+474		50	51L	0.430	0.900	0.387	3.515	28.759	58.516	0.571	27.5	825	0.20	0.642	88.989	1.201	1.369	0.335
11+495		51L	HW				3.515	29.094				900						
Kennedy Road - South Leg																		
5+221	EX.	101	100	0.540	0.900	0.486	0.486	15.000	91.990	0.124	49.0	375	1.23	0.194	63.995	1.757	1.862	0.438
5+172	EX.	100	23	0.270	0.900	0.243	0.729	15.438	90.166	0.183	80.0	450	1.80	0.383	47.734	2.405	2.357	0.566
5+092		23	Outlet	0.220	0.900	0.198	0.927	16.004	87.939	0.226	75.0	525	0.40	0.272	83.252	1.256	1.414	0.884
							0.927	16.889										
Kennedy Road North Leg																		
4+963		DCB 13	Outlet	0.250	0.900	0.225	0.225	15.000	91.990	0.057	7.0	400	1.00	0.175	32.792	1.587	1.405	0.083
11+420		Outlet					0.225	15.083			400 CSP N=0.024 Q=0.095							
						600 CSP TC=[illegible]15.129												
Mayfield Road - South Side Inlet																		
				0.270	0.900	0.243												
		CSP	CSP	1.120	0.250	0.280												
11+355		Inlet	Outlet	0.100	0.900	0.090	0.613	24.590	65.245	0.111	36.0	600	0.13	0.221	50.183	0.783	0.783	0.766
11+355							0.613	25.356			600 CSP N=0.024 Q=0.120							
						600 CSP TC=[illegible]25.820												
Mayfield Road - Kingfisher Park																		
						0.927												
						0.613												
		CSP	CSP	0.130	0.900	0.117												
11+410		Inlet	Outlet	1.230	0.250	0.308	1.965	25.820	63.069	0.344	34.0	750	0.21	0.510	67.460	1.155	1.241	0.456
								26.276			BIG O BOSS POLYTITE PIPE (SMOOTH WALL)							
Mayfield Road - North Side Inlet																		
						0.225												
				0.140	0.900	0.126												
		CSP	CSP	0.200	0.900	0.180												
11+370		Inlet	Outlet	1.520	0.250	0.380	0.911	27.190	60.843	0.154	38.0	[illegible]600	0.26	0.313	49.177	1.107	1.096	0.578
							0.911	27.768			600 CSP N=0.024 Q=0.170							
						600 CSP TC=[illegible]28.133												
DRAINAGE AREA 3																		
Mayfield Road - West of SWM Pond Inlet - Future																		
12+140	FUT	62.5	62.4	0.400	0.90	0.360	0.360	15.000	91.990	0.092	80.0	300	1.000	0.097	95.128	1.368	1.580	0.844
12+220	FUT	62.4	62.3	0.400	0.90	0.360	0.720	15.844	88.556	0.177	80.0	375	2.300	0.266	66.608	2.408	2.588	0.515
12+300	FUT	62.3	62.2	0.400	0.90	0.360	1.080	16.359	86.609	0.260	80.0	375	3.000	0.304	85.559	2.750	3.107	0.429
12+380	FUT	62.2	62.1	0.400	0.90	0.360	1.440	16.788	85.064	0.340	80.0	525	1.500	0.527	64.599	2.433	2.603	0.512
12+460	FUT	62.1	62	0.400	0.90	0.360	1.800	17.300	83.306	0.417	80.0	600	0.600	0.476	87.578	1.682	1.909	0.698
12+540		62	63	0.590	0.90	0.531	2.331	17.999	81.046	0.525	70.0	675	0.500	0.594	88.288	1.661	1.894	0.616
12+610		63					2.331	18.615										
Mayfield Road - East of SWM Pond Inlet																		
Heart Lake Road - North Leg-Future																		
4+670	FUT	734	733	0.320	0.90	0.288	0.288	15.000	91.990	0.074	80.0	300	1.500	0.118	62.137	1.675	1.776	0.751
				0.440	0.25	0.110												
4+750	FUT	733	732	0.290	0.90	0.261	0.659	15.751	88.920	0.163	80.0	375	2.750	0.291	55.983	2.633	2.685	0.497
				0.220	0.25	0.055												
4+830	FUT	732	731	0.290	0.90	0.261	0.975	16.247	87.022	0.236	80.0	375	2.900	0.299	78.936	2.703	3.014	0.442
				0.180	0.25	0.045												
4+910		731	73	0.290	0.90	0.261	1.281	16.690	85.413	0.304	26.0	525	0.700	0.360	84.467	1.662	1.878	0.231
				0.130	0.25	0.033												
4+965		73	67	0.250	0.90	0.225	1.539	16.920	84.601	0.362	26.0	600	0.400	0.388	93.104	1.373	1.579	0.274
4+965		67					1.539	17.195										

LOCATION

Mayfeld Road—Inder Heights Dr. to Heart Lake Rd.

DATE: January 18, 2008
DESIGNED BY: MG
CHECKED BY: ASL

STORM SEWER

Region of Peel / City of Brampton

DESIGN SHEET

Job Number: 602 10320

DESIGN PARAMETERS

DESIGN STORM : 1 in 10 Years

$R = A (T)^B$ Interpolation Equation

A = 35.1 MANNING'S n = 0.013 51.300

B = -0.695 MINIMUM COVER: 1.200 m -0.686

TIME OF ENTRY 15 min.

LOCATION	FROM M.H.	TO M.H.	AREA (ha)	C	A x C (ha)	ACCUM. AREA (ha)	T of C (min)	I (mm/h)	Q (m³/s)	LENGTH (m)	PIPE SIZE (mm)	SLOPE (%)	CAP. (FULL) (m³/s)	Q/Qa CAP. (%)	VEL. (FULL) (m/S)	VEL. (ACT) (m/S)	MANHOLE TIME OF FLOW (min)
Mayfield Road																	
			0.61	0.25	0.153												
12+820	69	68	0.28	0.90	0.252	0.405	15.000	91.990	0.103	37.0	375	0.50	0.124	83.371	1.123	1.263	0.488
			0.11	0.25	0.028												
12+780	68	67	0.29	0.90	0.261	0.693	15.488	89.964	0.173	53.5	450	0.40	0.180	96.042	1.134	1.315	0.678
12+731	67					0.693	16.166										
Mayfield Road																	
12+731	67	66	0.070	0.90	0.063	2.295	17.195	83.661	0.533	50.0	750	0.400	0.704	75.731	1.594	1.761	0.473
12+680	66	65	0.160	0.90	0.144	2.439	17.668	82.097	0.556	30.0	825	0.350	0.849	65.483	1.589	1.700	0.294
12+650	65	64	0.270	0.90	0.243	2.682	17.962	81.161	0.605	29.0	900	0.360	1.086	55.656	1.707	1.742	0.278
12+620	64	63	0.150	0.90	0.135	2.817	18.240	80.300	0.628	17.0	900	0.350	1.071	58.659	1.683	1.751	0.162
12+610	63					2.817	18.401										
Mayfield Road - SWM Pond Inlet																	
12+610	63	63R	0.000	0.900	0.000	5.148	18.401	79.809	1.141	19.0	975	0.60	1.736	65.738	2.325	2.488	0.127
12+611	63R					5.148	18.529										
12+710	63R2	63R1	0.10	0.90	0.090	0.090	15.000	91.990	0.023	50.0	300	0.50	0.068	33.633	0.967	0.856	0.973
12+660	63R1	63R	0.03	0.35	0.011	0.101	15.973	88.056	0.025	49.5	300	0.50	0.068	35.951	0.967	0.871	0.948
12+611	63R					0.101	16.921										
12+611	63R	HW	0.050	0.350	0.018	5.266	18.529	79.427	1.162	18.0	1050	0.50	1.931	60.165	2.230	2.341	0.128
12+612	HW					5.266	18.657										

Memo

Stantec

To:	Dave Hallman Kitchener Office	From:	Grant Whitehead Kitchener Office
File:	60210320	Date:	December 20, 2007

Reference: Mayfield Road/Kennedy Road SWM Pond
Heart Lake Wetland Complex, Groundwater Level Monitoring

In July 2006, Stantec installed a drive-point piezometer within the Provincially Significant Wetland (PSW) located to the north and east of the proposed stormwater management (SWM) facility near the intersection of Mayfield Road and Kennedy Road (Figure 1). This wetland area is part of the greater Heart Lake Wetland Complex and the purpose of the piezometer installation was to establish a baseline in seasonal groundwater level fluctuations within the PSW prior to the construction of the SWM facility. Subsequently, these baseline data will be compared to post-development water level fluctuations within the PSW, which will then be used to evaluate whether the form and function of the wetland would be notably impacted as a result of the SWM facility operation.

The installed drive-point piezometer consists of a 19 mm diameter, 0.42 m long steel screen that is connected to a series of 25 mm diameter steel risers. The piezometer was inserted into the PSW using manual driving techniques and then developed to remove fine-grained material from around the screened interval in order to obtain groundwater levels representative of subsurface conditions. Groundwater level fluctuations within DP1-06 were recorded using a Solinst® LT Levelogger®, which was programmed to record water level measurements at 15-minute intervals. Manual water level measurements were also collected using a battery operated probe and calibrated tape to compliment the Levelogger data. Manual water depths were recorded in meters below the top of the well casing. Monitoring of groundwater level fluctuations in the PSW occurred from July to November, 2006, and from May to October, 2007. Monitoring was not performed during months typically characterized by sub-zero temperatures, given that the freezing of the water column within piezometer pipes have been documented to damage water level recording equipment such as Leveloggers. The results of this groundwater level monitoring are presented in Figure 2.

Water levels in DP1-06 experienced an overall increase of approximately 1.5 m throughout the 2006 monitoring period, with water levels increasing steadily from an elevation of 253.68 m AMSL in July to 255.15 m AMSL in November (Figure 2). Total precipitation recorded over this monitoring period was 443 mm, which was obtained from the Sandhill Climate Station (CS) located approximately 10 km to the north of subject area. In comparison, the 30-year average for total precipitation over this same period is 315 mm. Consequently, these data suggested that this observed increase in the water table was likely attributable to the overall greater than average precipitation (+128 mm) that occurred throughout the region over the monitoring period.

In 2007, groundwater elevations recorded at DP1-06 remained relatively constant, with the water table experiencing an overall decline of 0.17 m from May (255.48 m AMSL) to October (255.31 m AMSL) (Figure 2). Total rainfall that occurred over this monitoring period (May to October) was roughly 268 mm, which was 217 mm less than the 30-year average for total precipitation over this same period (i.e., 485 mm). The ability of the water levels beneath the PSW to remain relatively unchanged in response to the lack of rainfall suggests that this wetland system is likely located in an area where upward vertical hydraulic gradients are present. These data also suggest that the steady water level increase observed in DP1-06 during 2006 was a partial reflection of the water level within the pipe equilibrating with the surrounding shallow groundwater system.

Since the re-initiation of groundwater level monitoring within the PSW occurred in late May 2007, it is reasonable to assume that the monitoring completed to date has not yet captured the high water table condition in the wetland system. Overall, the highest water table elevation that has been recorded in the vicinity of DP1-06 during the monitoring period is 255.48 m AMSL.

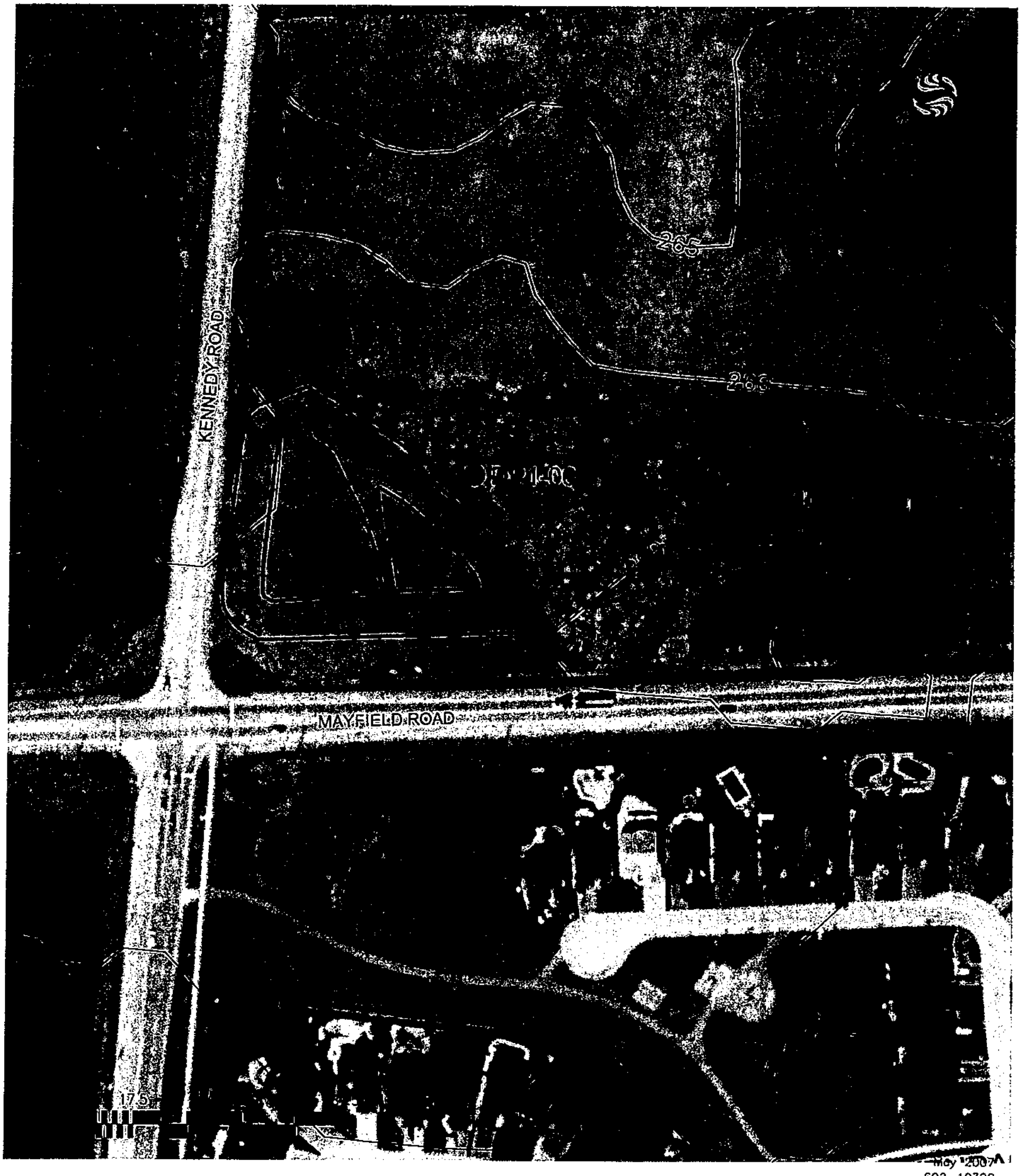
In the Toronto and Region Conservation Authority (TRCA) letter dated June 21, 2007, the TRCA requests that the monitoring of water levels in the PSW be continued during and after the construction of the proposed SWM facility. Additionally, the TRCA requests that this monitoring be started earlier in the year (i.e., prior to May) so that water level fluctuations in the PSW associated with the spring thaw are recorded. As a result, Stantec will continue with the monitoring of groundwater levels at DP1-06, with this monitoring being re-initiated in March 2008.

STANEC CONSULTING LTD.

G. Whitehead

Grant Whitehead, MES
Environmental Scientist
grant.whitehead@stantec.com

Attachment: Figure 1 – Site Plan
Figure 2 – Water Level Hydrograph - DP1-06



V:\01609\active\60210320_Mayfield_Road_Reconstruction\planning\drawing\May 2007 - Wetland Monitoring\60210320_em_Kennedy.dwg [Site Plan8x11]
2007-12-03 02:26PM By: ccalhoun

May 2007
602-10320

Legend

● DP1-06 Wetland Piezometer (Stantec, 2006)
—— Proposed Stormwater Management Pond

Notes

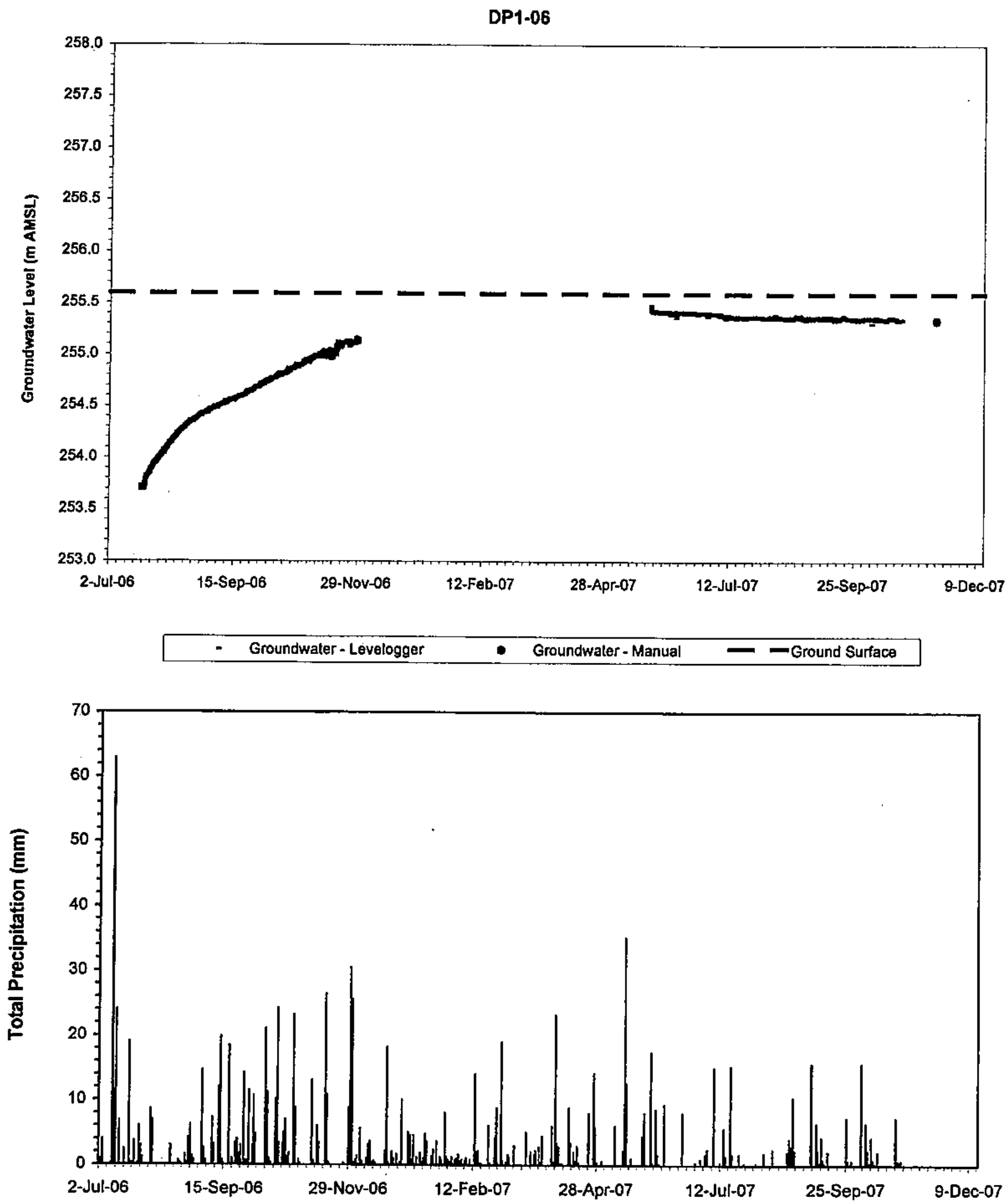
1. Aerial Photography: Toronto and Region Conservation Authority, 2000.
2. Ground surface contours: Ontario Base Mapping Digital Elevation Model, 2006.

Stantec

Client/Project
Region of Peel
Kennedy and Mayfield Road SWM Pond
PSW Groundwater Level Monitoring

Figure No.
1

Title
Site Plan

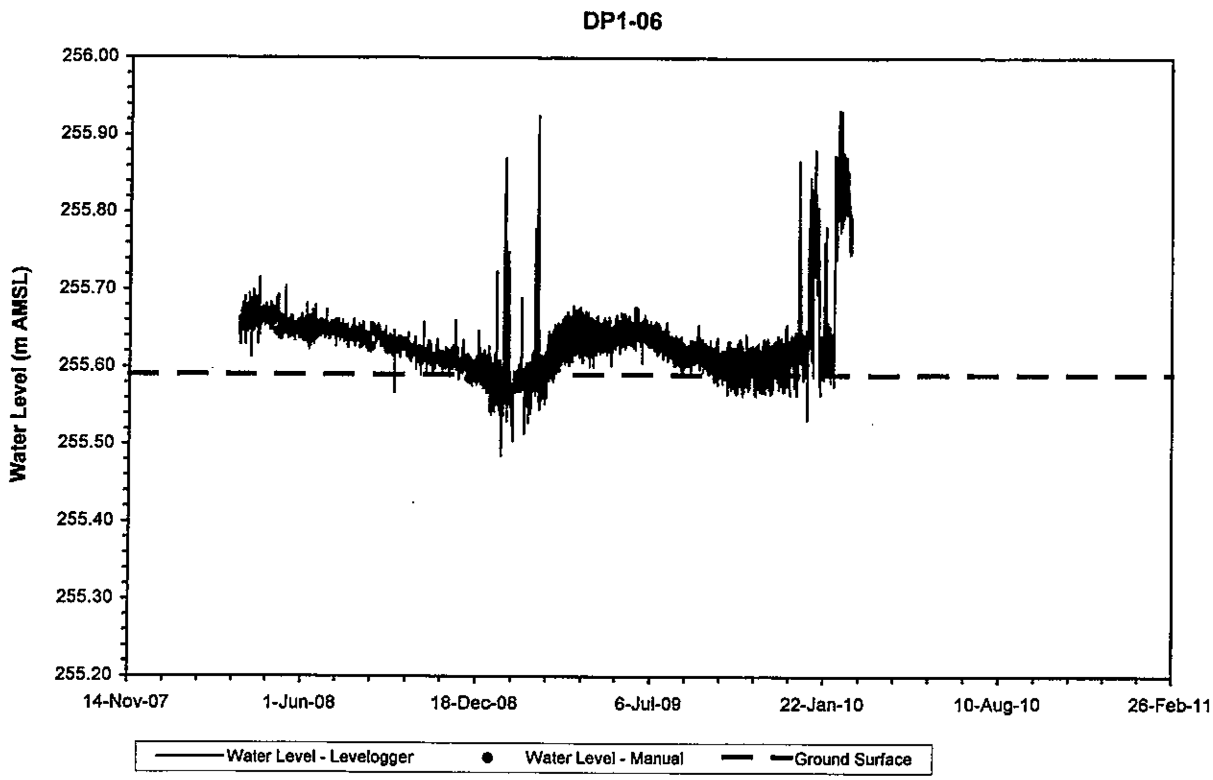


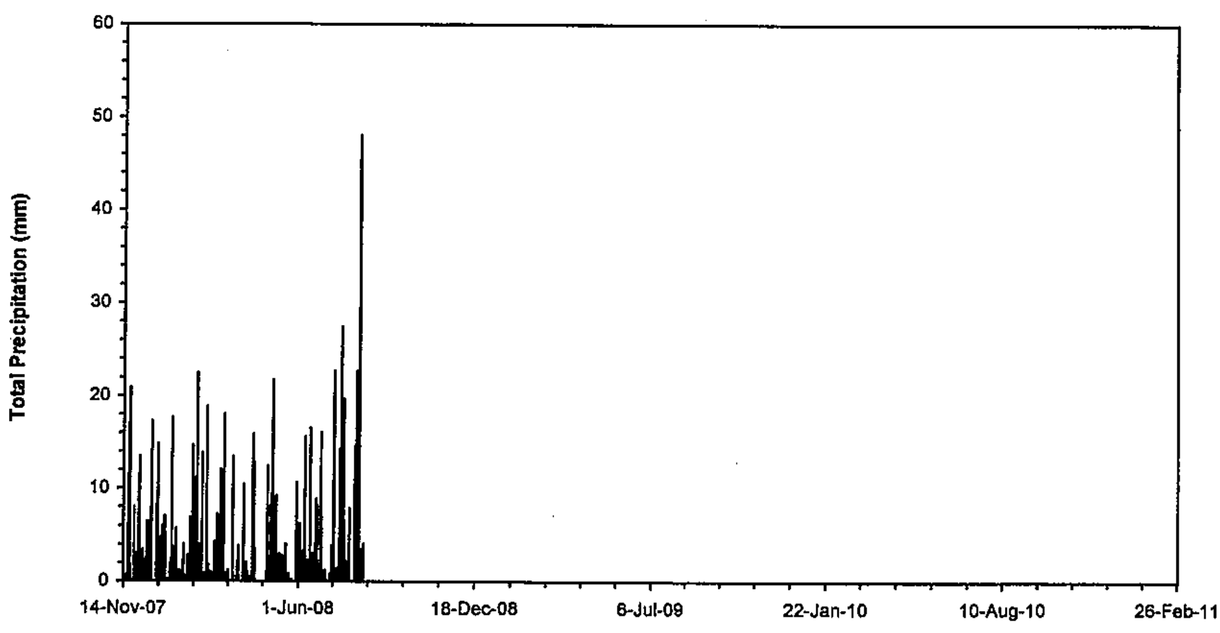
Stantec

MAYFIELD ROAD/KENNEDY ROAD SWM POND
HEART LAKE WETLAND COMPLEX - WATER LEVEL MONITORING

WATER LEVEL HYDROGRAPH
DP1-06

DATE:	SCALE:	PROJECT No.	FIGURE No.
14-Dec-07	not to scale	60210320	FIGURE 2



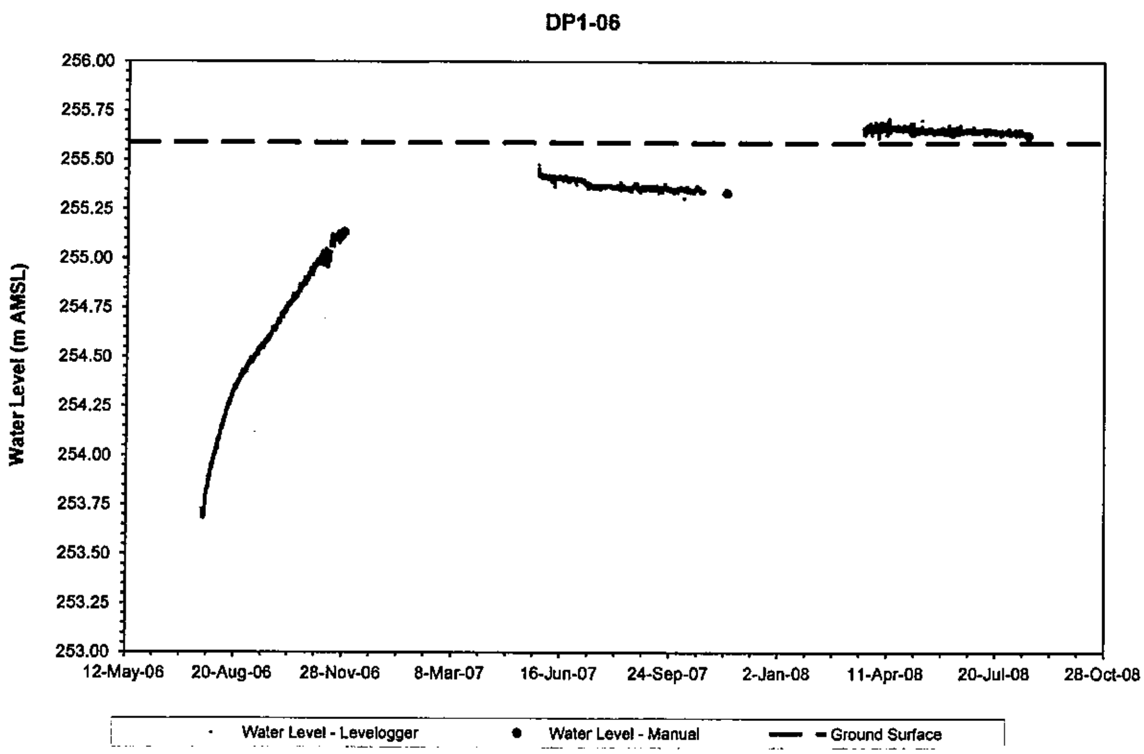


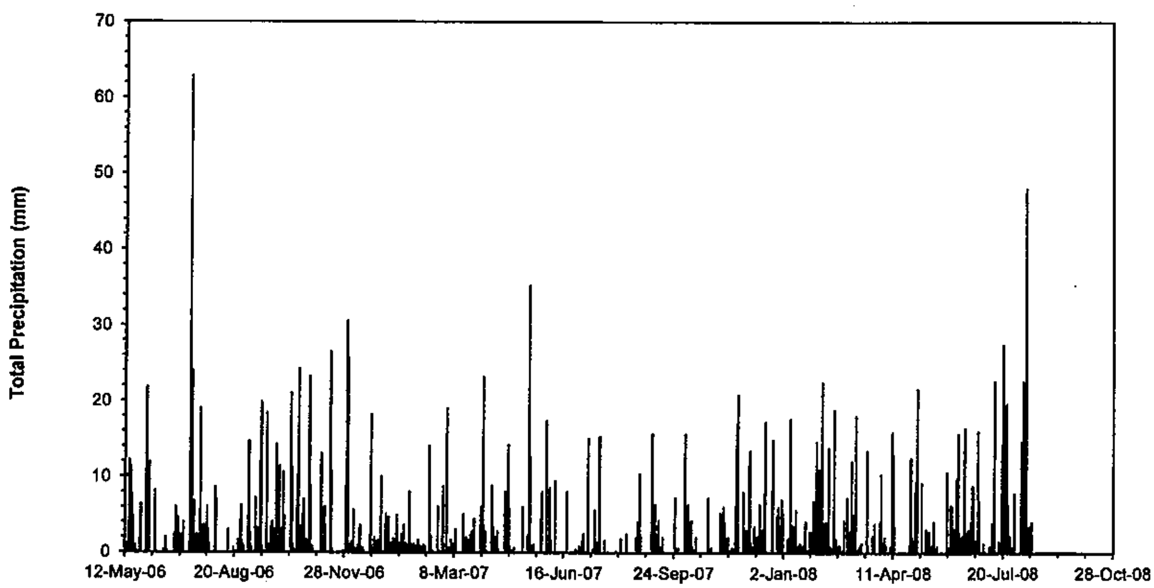
Stantec

MAYFIELD ROAD/KENNEDY ROAD SWM POND
HEART LAKE WETLAND COMPLEX - WATER LEVEL MONITORING

WATER LEVEL HYDROGRAPH
DP1-06

DATE:	SCALE:	PROJECT No.	FIGURE No.
09-Jul-10	not to scale	60210320	FIGURE 2





Stantec

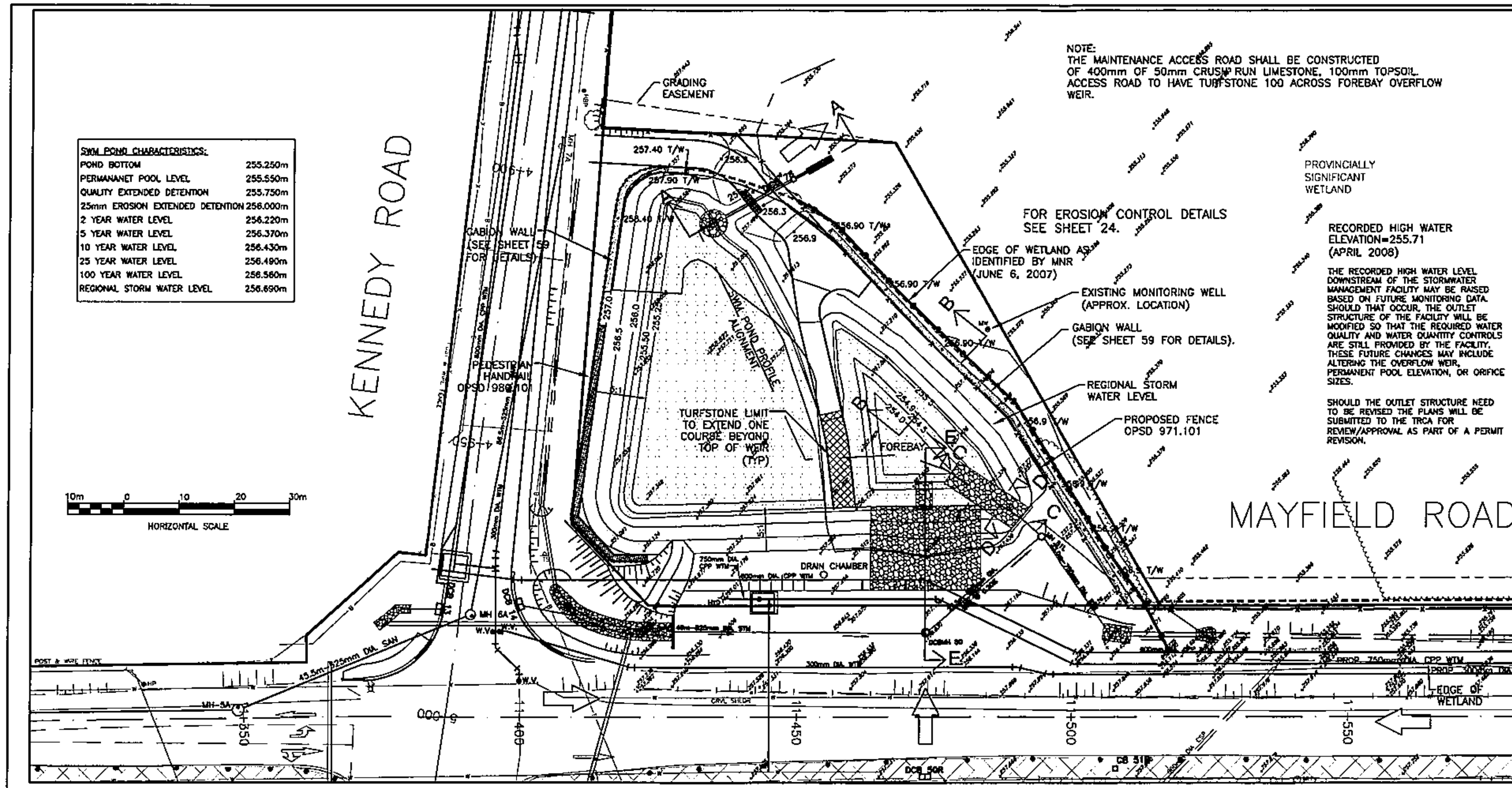
MAYFIELD ROAD/KENNEDY ROAD SWM POND
HEART LAKE WETLAND COMPLEX - WATER LEVEL MONITORING

WATER LEVEL HYDROGRAPH
DP1-06

DATE:	SCALE:	PROJECT No.	FIGURE No.
15-Aug-08	not to scale	60210320	FIGURE 2

REVISIONS		
DATE	DETAILS	INIT.
2008.06.25	RELEASED FOR TENDER	DJH
2008.08.11	ISSUED FOR CONSTRUCTION	DJH
2011.01.17	AS RECORDED	DJH

NOTE:
THE MAINTENANCE ACCESS ROAD SHALL BE CONSTRUCTED OF 400mm OF 50mm CRUSH RUN LIMESTONE, 100mm TOPSOIL. ACCESS ROAD TO HAVE TURFSTONE 100 ACROSS FOREBAY OVERFLOW WEIR.



SWM POND CHARACTERISTICS:	
POND BOTTOM	255.250m
PERMANANET POOL LEVEL	255.550m
QUALITY EXTENDED DETENTION	255.750m
25mm EROSION EXTENDED DETENTION	256.000m
2 YEAR WATER LEVEL	256.220m
5 YEAR WATER LEVEL	256.370m
10 YEAR WATER LEVEL	256.430m
25 YEAR WATER LEVEL	256.490m
100 YEAR WATER LEVEL	256.580m
REGIONAL STORM WATER LEVEL	256.690m

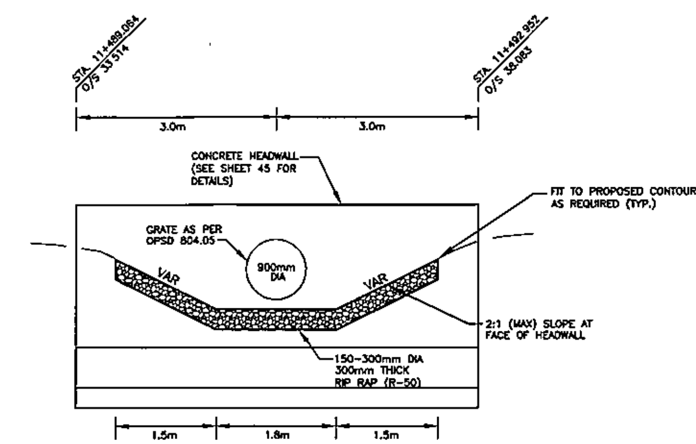
RECORDED HIGH WATER ELEVATION=255.71 (APRIL 2008)

THE RECORDED HIGH WATER LEVEL DOWNSTREAM OF THE STORMWATER MANAGEMENT FACILITY MAY BE RAISED BASED ON FUTURE MONITORING DATA. SHOULD THAT OCCUR, THE OUTLET STRUCTURE OF THE FACILITY WILL BE MODIFIED SO THAT THE REQUIRED WATER QUALITY AND WATER QUANTITY CONTROLS ARE STILL PROVIDED BY THE FACILITY. THESE FUTURE CHANGES MAY INCLUDE ALTERING THE OVERFLOW WEIR, PERMANENT POOL ELEVATION, OR ORIFICE SIZES.

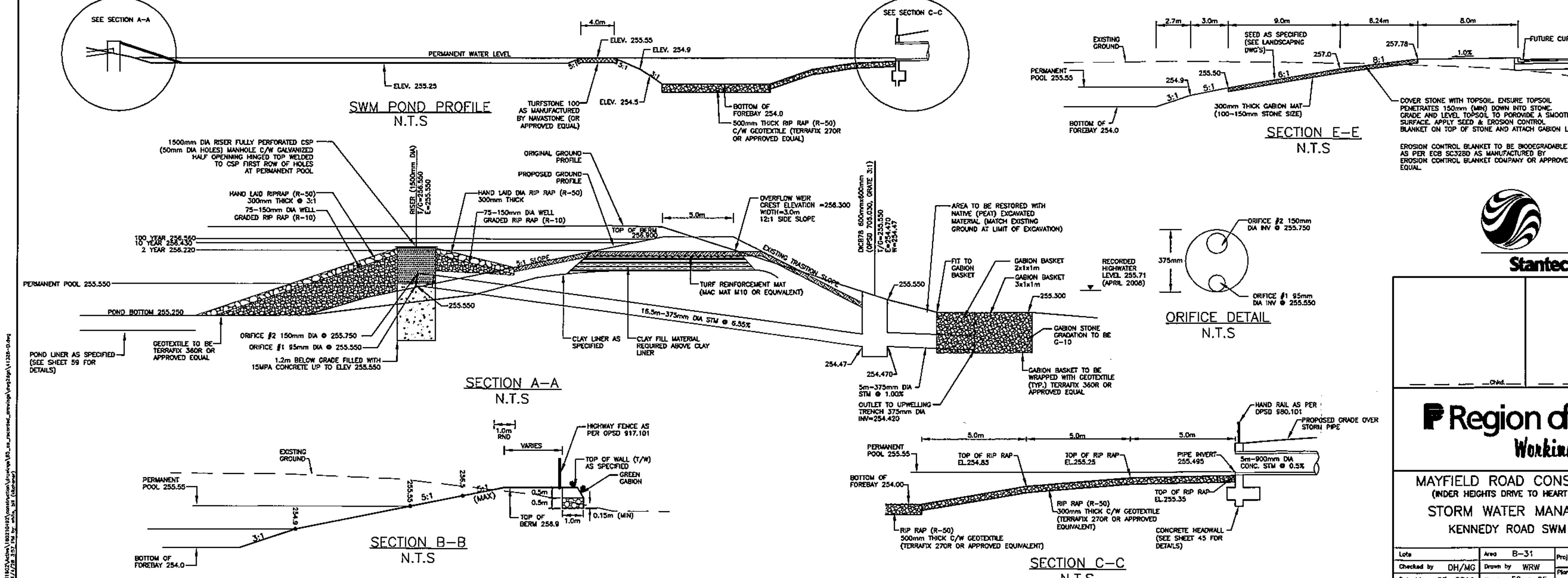
SHOULD THE OUTLET STRUCTURE NEED TO BE REVISED THE PLANS WILL BE SUBMITTED TO THE TRCA FOR REVIEW/APPROVAL AS PART OF A PERMIT REVISION.

LEGEND

- EXISTING SPOT ELEVATION
- MAJOR STORM FLOW
- PROPOSED SPOT ELEVATION
- PROPOSED CONTOURS
- SILT FENCE
- SHEET PILE
- EXISTING PROPERTY LINE
- ULTIMATE R.O.W.



SECTION D-D
N.T.S

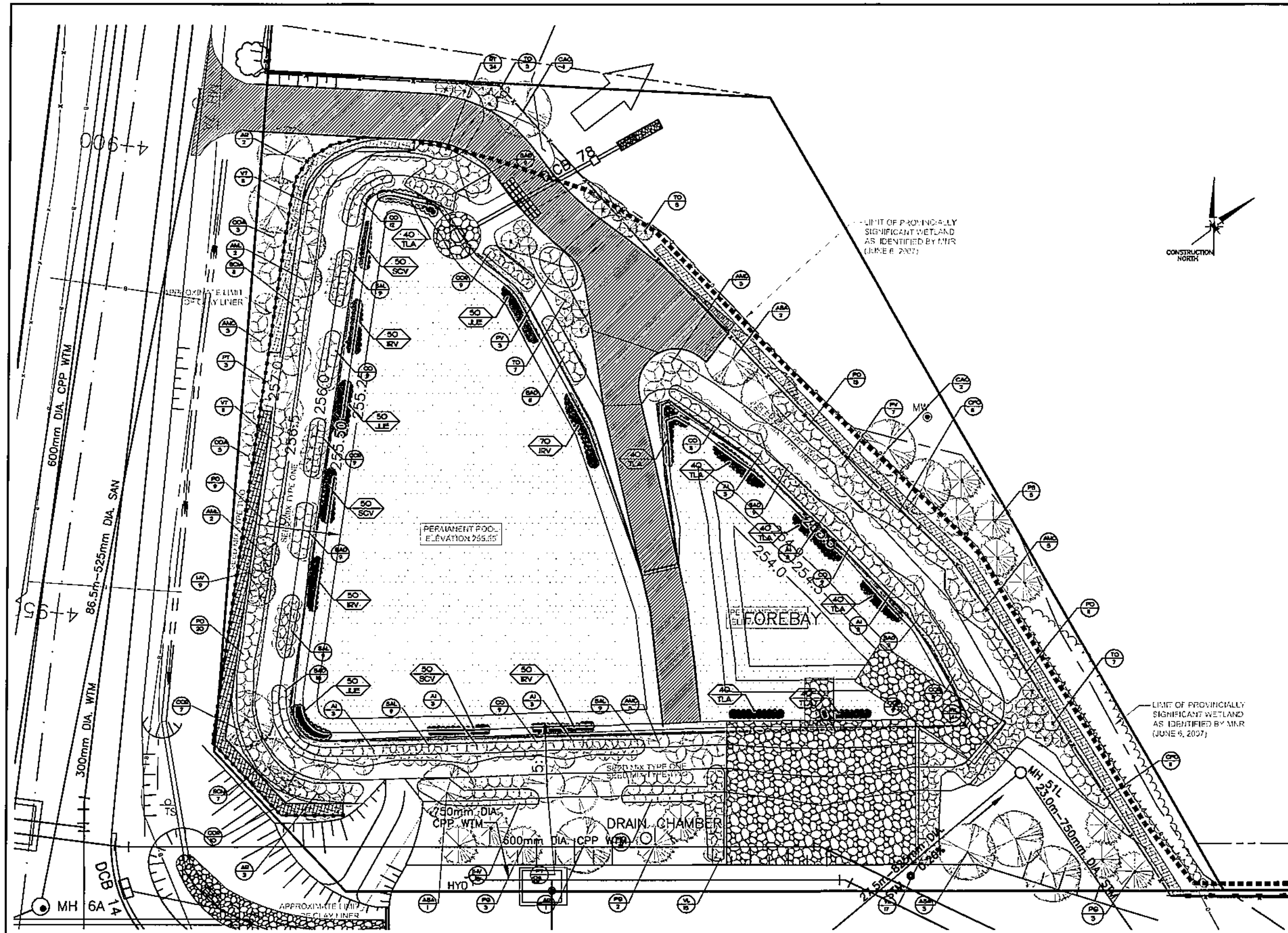


Stantec

Region of Peel
Working for you

MAYFIELD ROAD CONSTRUCTION
(INDER HEIGHTS DRIVE TO HEART LAKE ROAD)
STORM WATER MANAGEMENT
KENNEDY ROAD SWM POND

Lots	Area B-31	Project No. 01-4830
Checked by DH/MG	Drawn by WRW	Plan No. 41328-D
Date Mar. 25, 2011	Sheet 58 of 65	



STORMWATER MANAGEMENT POND PLANTING SCALE 1:250

LANDSCAPE NOTES:

1 CONTRACTOR SHALL SUPPLY ALL PLANTS AND MATERIALS IN QUANTITIES SUFFICIENT TO COMPLETE WORK SHOWN ON THIS DRAWING. ANY DISCREPANCIES BETWEEN QUANTITIES SHALL BE REPORTED TO THE LANDSCAPE ARCHITECT FOR DIRECTION.

2 PLANT MATERIALS COLLECTED FROM WILD SOURCES WILL NOT BE ACCEPTED. LANDSCAPE ARCHITECT MAY REQUIRE THAT SUPPLIER INVOICES FOR PLANT MATERIAL BE SUBMITTED FOR INSPECTION.

3 STAKING (LAYOUT) OF PLANT MATERIALS TO BE APPROVED BY LANDSCAPE ARCHITECT PRIOR TO INSTALLATION. DRAWING MAY BE SCALED FOR APPROXIMATE LAYOUT OF INDIVIDUAL TREES AND PLANTING BEDS.

4 LANDSCAPE ARCHITECT RESERVES THE RIGHT TO REFUSE ACCEPTANCE OF ANY PLANT DISPLAYING POOR GROWTH HABITS INJURY OR DISEASE. ANY PLANT MATERIAL THAT IS REJECTED BY THE LANDSCAPE ARCHITECT WILL BE PROMPTLY REMOVED FROM THE SITE BY THE CONTRACTOR AND REPLACED WITH MATERIAL OF ACCEPTABLE QUALITY AT NO ADDITIONAL COST TO THE PROJECT.

5 ALL DECIDUOUS AND CONIFEROUS TREES AND SHRUBS SHALL BE PLANTED AND STAKED IN ACCORDANCE WITH THE PLANTING DETAILS ON THIS DRAWING.

6 ALL PLANT MATERIALS TO CONFORM TO THE CANADIAN NURSERY LANDSCAPE ASSOCIATION (CNLA) FOR VARIETY, SIZE AND CONDITION. ANY PLANTS THAT DO NOT CONFORM TO THESE STANDARDS WILL BE PROMPTLY REMOVED FROM THE SITE BY THE CONTRACTOR AT NO ADDITIONAL COST TO THE PROJECT.

7 ANY SUBSTITUTIONS OF PLANT MATERIALS OR QUANTITIES REQUIRES THE WRITTEN APPROVAL OF THE LANDSCAPE ARCHITECT.

8 PLANTS ARE NOT TO BE INSTALLED OR TRANSPLANTED DURING EXTREME HEAT, DROUGHT OR OTHER UNDESIRABLE CONDITIONS. CONTRACTOR SHALL NOT PROCEED IN UNCERTAINTY. CONTACT LANDSCAPE ARCHITECT FOR DIRECTION.

9 THE CONTRACTOR SHALL RELOCATE ANY TREE OR SHRUB ON THE PROPERTY AS DIRECTED BY THE LANDSCAPE ARCHITECT.

10 ALL PLANT MATERIALS WILL BE PLANTED IN AN APPROVED TOPSOIL. NO ADDITIONAL SOILS OR ADDITIVES WILL BE PERMITTED UNLESS SPECIFIED BY THE CONTRACTOR AT NO ADDITIONAL COST TO THE PROJECT.

11 TOPSOIL TO BE FREE FROM WEEDS, SUBSOIL, ROOTS, STONES, LUMPS OF CLAY AND TOXIC MATERIAL.

12 SHREDDED BARK MULCH TO BE UNIFORMLY APPLIED UNDER ALL TREES AND IN PLANTING BEDS 100 mm IN THICKNESS. SAMPLE TO BE SUBMITTED TO THE LANDSCAPE ARCHITECT FOR APPROVAL PRIOR TO PLACEMENT.

13 INSTALL APPROVED WRAPAROUND TYPE TREE GUARDS ON ALL DECIDUOUS TREES OVER 2000 mm IN HEIGHT. ENSURE THAT THE BOTTOM 50 mm OF THE TREE GUARD EXTENDS BELOW SOIL TO PREVENT ENTRY BY RODENTS.

14 ANY DEAD OR DAMAGED BRANCHES OF TREES OR SHRUBS TO BE PRUNED ACCORDING TO STANDARDS AND FINING APPROPRIATE TO EACH SPECIES.

15 CONTRACTOR TO VERIFY ALL DIMENSIONS AND QUANTITIES AND REPORT ANY DISCREPANCIES TO THE LANDSCAPE ARCHITECT.

16 CONTRACTOR TO IDENTIFY WITH OWNER AND LANDSCAPE ARCHITECT ANY MAINTENANCE REQUIREMENTS NECESSARY FOR WARRANTY PURPOSES.

17 ALL WORKMANSHIP AND MATERIALS TO BE GUARANTEED FOR TWO YEARS FOLLOWING SUBSTANTIAL COMPLETION AS DOCUMENTED BY THE LANDSCAPE ARCHITECT AND/OR MUNICIPALITY.

18 LANDSCAPE ARCHITECT RESERVES THE RIGHT TO EXTEND CONTRACTOR'S WARRANTY RESPONSIBILITIES FOR AN ADDITIONAL YEAR IF, AT THE END OF INITIAL WARRANTY PERIOD, LEAF DEVELOPMENT AND GROWTH IS NOT SUFFICIENT TO ENSURE FUTURE SURVIVAL AS DETERMINED BY THE LANDSCAPE ARCHITECT.

19 PROVIDE UNIT PRICES TO ALLOW FOR ADDITIONS / DELETIONS TO THE CONTACT.

20 CONTRACTOR TO VERIFY ON SITE ALL UNDERGROUND UTILITY LOCATIONS PRIOR TO PLANTING.

21 CONTRACTOR IS RESPONSIBLE FOR ANY DAMAGE TO EXISTING LANDSCAPED AREAS AND MUST MAKE ALL NECESSARY RESTORATIONS AND REPAIRS.

22 CONTRACTOR SHALL REMOVE ALL TREE STAKES, GUY WIRES AND ATTACHMENT DEVICES, RODENT GUARDS, AND PROTECTIVE BARRIERS FOR WETLAND PLANTINGS AFTER THE SPECIFIED WARRANTY PERIOD.

23 ALL TREE LOCATIONS SHALL CONFORM TO THE SETBACK REQUIREMENTS ESTABLISHED BY THE CITY OR MUNICIPALITY.

24 CONTRACTOR SHALL NOT REMOVE TREE PROTECTION FENCING UNTIL ALL CONSTRUCTION IS COMPLETED, SOILS ARE STABILIZED AND ALL OF THE EQUIPMENT HAS BEEN REMOVED FROM THE SITE.

NOTE:
ALL MASS PLANTINGS TO BE DRESSSED WITH 100mm MINIMUM DEPTH OF CONTINUOUS SHREDDED BARK MULCH PLANTING BED.

REVISIONS

DATE	DETAILS	INIT.
2008.06.25	RELEASED FOR TENDER	DJH
2008.08.11	ISSUED FOR CONSTRUCTION	DJH
2011.01.17	AS RECORDED	DJH

LEGEND

- o 256.9 — PROPOSED SPOT ELEVATION
- 259.5 — PROPOSED CONTOURS
- PROPOSED DECIDUOUS TREE
- PROPOSED COLONIZING NATIVE SHRUBS
- PROPOSED EMERGENT PLANTINGS
- PROPOSED 5.0m WIDE MAINTENANCE ACCESS
- GREEN GABION
- MULCH BED
- SEED MIX SEPARATION

SWM POND CHARACTERISTICS:	
POND BOTTOM	255.250m
PERMANENT POOL LEVEL	255.550m
QUALITY EXTENDED DETENTION	255.750m
25mm EROSION EXTENDED DETENTION	256.000m
2 YEAR WATER LEVEL	256.220m
5 YEAR WATER LEVEL	256.370m
10 YEAR WATER LEVEL	256.430m
25 YEAR WATER LEVEL	256.490m
100 YEAR WATER LEVEL	256.560m
REGIONAL STORM WATER LEVEL	256.690m

SEED MIX TYPE ONE: TO BE PLANTED BELOW ELEVATION 256.25

MEADOW MARSH MIX

Available from:

1. OSC, 330 Phillip St. P.O. Box 7, Waterloo, ON, N2J 3Z6. Phone: (519) 886-0557
2. Pickseed P.O. Box 304, Lindsay, ON, K9V 4S3. Phone: (705) 878-9240
3. Prairie Nursery, P.O. Box 306, Westfield, WI, 53964. Phone: (608) 296-3679

BOTANICAL NAME	COMMON NAME	PERCENTAGE
Agrostis stolonifera	Creeping Bentgrass	4%
Anemone canadensis	Canada Anemone	4%
Asclepia incarnata	Red Milkweed	4%
Aster novae angliae	New England Aster	4%
Bidens cernua	Nodding Beggar Ticks	4%
Calamagrostis canadensis	Bluejoint Grass	5%
Carex bebbii	Bebb's Sedge	4%
Carex crinita	Fringed Sedge	4%
Carex stipata	Awl Sedge	5%
Carex vulpinoidea	Fox Sedge	5%
Chelone glabra	Turtlehead	4%
Elymus virginicus	Virginia Wild-Rye	3%
Eupatorium maculatum	Joe Pye Weed	5%
Eupatorium perfoliatum	Boneset	4%
Glyceria striata	Manna Grass	5%
Hypericum pyramidatum	Great St. John's Wort	5%
Leersia oryzoides	Rice Cut-grass	4%
Lobelia siphilitica	Great (or Blue) Lobelia	4%
Onoclea sensibilis	Sensitive Fern	4%
Poa palustris	Fowl Bluegrass	4%
Leersia oryzoides	Rice Cut-grass	4%
Rudbeckia triloba	Branched Coneflower	4%
Scirpus validus	Softstem Bulrush	4%
Verbena hastata	Blue Vervain	3%

SEEDING RATES
12kg/ha Meadow Marsh Mix
56kg/ha Annual Rye

NURSE CROP - Annual Rye

SEED MIX TYPE TWO: TO BE PLANTED ABOVE ELEVATION 256.25

PERENNIAL MEADOW MIX

Botanical Name	Common Name	Percentage
Anemone canadensis	Canada Anemone	10%
Aster ericoides	Heath Aster	10%
Aster novae angliae	New England Aster	10%
Calamagrostis canadensis	Blue Joint Grass	10%
Eupatorium maculatum	Joe Pye Weed	10%
Eupatorium perfoliatum	Boneset	5%
Helianthus decapetalus	Thin Leaved Sunflower	10%
Monarda fistulosa	Wild Bergamont	10%
Oenothera parviflora	Evening Primrose	10%
Rudbekia hirta	Black Eyed Susan	5%
Solidago canadensis	Goldenrod	10%

Seeding Rates:
10kg/ha Perennial Meadow Mix
25kg/ha Annual Rye

Nurse Crop - Annual Rye

*NOTE
ALL SEED SHALL BE APPLIED WITH A PNEUMATICALLY BLOWN MIXTURE OF COMPOSTED ORGANICS (TERRASEEDED) AS PER SPECIFICATIONS

Stormwater Management Pond Plant List

SYM	Qty	Botanical Name	Common Name	CAL (mm)	HT (cm)	Root	Remarks
DECIDUOUS TREES:							
AML	4	Amelanchier laevis	Alleghany Serviceberry		250	Pot	
AR	6	Acer rubrum	Red Maple		250	Pot	
ASA	6	Acer saccharum	Sugar Maple		250	Pot	
CAO	3	Carya ovata	Shagbark Hickory		250	Pot	
PT	6	Populus tremuloides	Trembling Aspen		250.	Pot	
CONIFEROUS TREES							
PG	8	Picea glauca	White Spruce		125	W.B.	
PS	5	Pinus strobus	Eastern White Pine		125	W.B.	
TO	24	Thuja occidentalis	White Cedar		100	B.B	
DECIDUOUS SHRUBS:							
AI	18	Alnus incana	Speckled Alder		100	3 Gal.	
AMC	10	Amelanchier canadensis	Serviceberry		60	3 Gal.	
CO	50	Cephalanthus occidentalis	Buttonbush		60	3 Gal.	
COA	6	Cornus alternifolia	Pagoda Dogwood		100	3 Gal.	
CFO	22	Cornus racemosa	Gray Dogwood		60	3 Gal.	
COR	55	Cornus stolonifera	Red Osier Dogwood		60	3 Gal.	
HV	27	Hamamelis virginiana	Virginian Witch Hazel		60	3 Gal.	
PO	63	Physocarpus opulifolius	Common Ninebark		60	3 Gal.	
PV	10	Prunus virginiana	Chokecherry		100	3 Gal.	
RT	24	Rhus typhina	Staghorn Sumac		100	3 Gal.	
SAD	65	Salix discolor	Pussywillow		60	3 Gal.	
SAL	36	Spiraea alba	Meadowsweet		60	3 Gal.	
SCM	18	Sambucus canadensis	Elderberry		60	3 Gal.	
VL	46	Viburnum lentago	Nannyberry		60	3 Gal.	
VT	22	Viburnum trilobum	Highbush Cranberry		60	3 Gal.	

Emergent Zone Plant List

SYM	Qty	Botanical Name	Common Name	Root	Remarks
IRV	220	Iris versicolour	Blue Flag Iris	15cm Pot	500mm O.C.
JUE	150	Juncus effusus	Soft Rush	15cm Pot	500mm O.C.
SCV	150	Scirpus validus	Bull Rush	15cm Pot	500mm O.C.
TLA	240	Typha latifolia	Common Cattail	15cm Pot	500mm O.C.

Vegetation Calculation Table

Zone	Area (m^2)	Linear Metres	Tree Qty	Shrub Qty	Emergents Qty	Total Coverage
1	Not applicable. Forebay is only area with over 1m depth and is routinely dredged					
2		251			760	3 plants/l.m.
3, 4, 5	2200		62	472		2022m^2(92%)

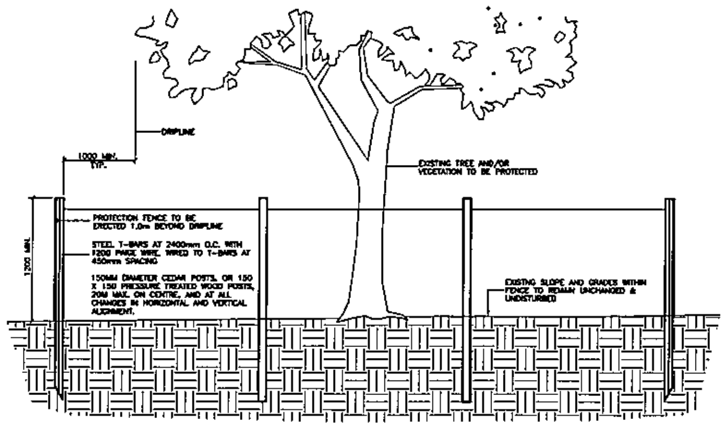
Stantec

Region of Peel
Working for you

MAYFIELD ROAD CONSTRUCTION
(INDER HEIGHTS DRIVE TO HEART LAKE ROAD)
LANDSCAPING
KENNEDY ROAD SWM POND

Lots	Area B-31	Project No. 01-4830
Checked by HTL	Drawn by DC	Plan No. 41330-D
Date Apr 28, 2011	Sheet 60 of 65	

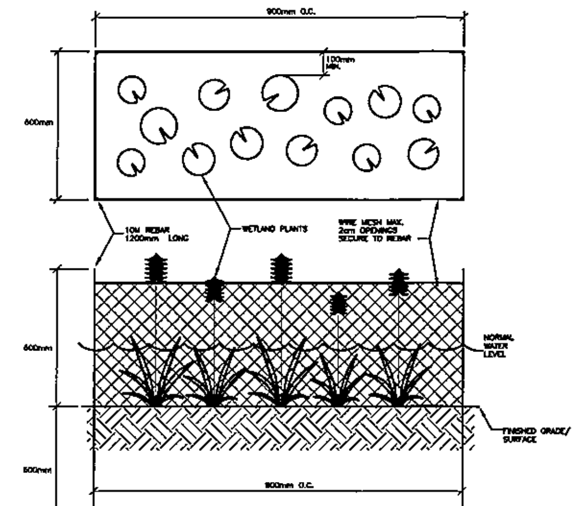
REVISIONS		
DATE	DETAILS	INIT.
2008.06.25	RELEASED FOR TENDER	DJH
2008.08.11	ISSUED FOR CONSTRUCTION	DJH
2011.01.17	AS RECORDED	DJH



NOTES:

1. ATTACHMENT OF FENCE TO TREES IS NOT ALLOWED.
2. ANY EXPOSED ROOTS ARE TO BE HAND PRUNED USING PROPER ARBORCULTURE PRACTICES.
3. UNDER NO CIRCUMSTANCES SHALL ANY CONSTRUCTION MATERIALS OR EQUIPMENT BE PLACED WITHIN THE TREE PROTECTION HOARDING.
4. ALL TREE PROTECTION TO BE ERECTED PRIOR TO ANY CONSTRUCTION ACTIVITY AND IS TO REMAIN IN PLACE UNTIL ALL CONSTRUCTION HAS BEEN COMPLETED.

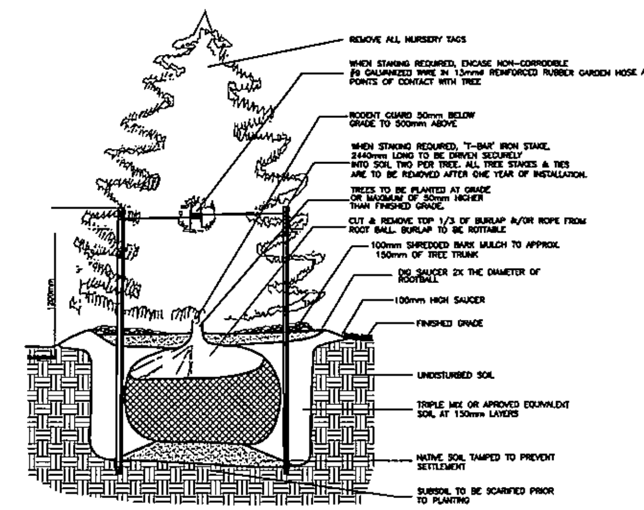
D/1 TREE PROTECTION FENCE
N.T.S.



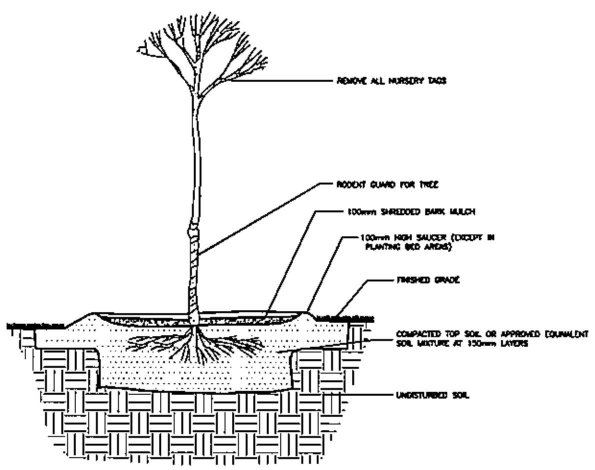
NOTES:

1. CONTRACTOR TO REMOVE BARRIER ONCE PLANTS HAVE ESTABLISHED.
2. SPACING OF PLANT MATERIALS TO BE A MINIMUM OF 200mm TO 460mm O.C.

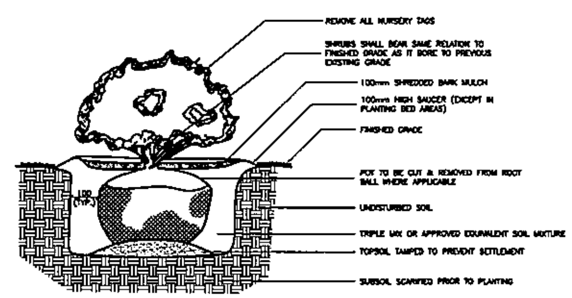
D/2 PROTECTIVE BARRIER FOR WETLAND PLANTINGS
N.T.S.



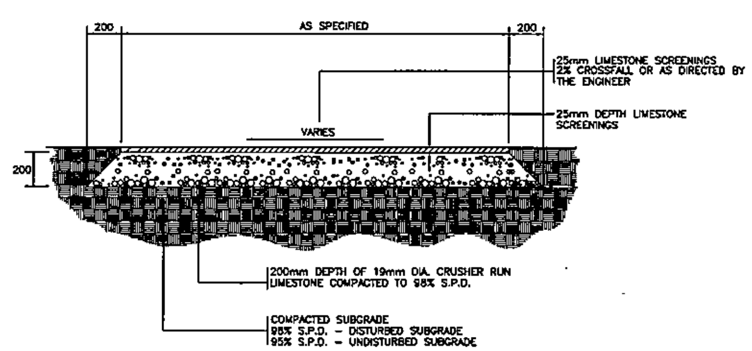
D/3 CONIFEROUS TREE PLANTING DETAIL
N.T.S.



D/4 BAREROOT WHIP PLANTING DETAIL
N.T.S.



D/5 SHRUB PLANTING DETAIL
N.T.S.



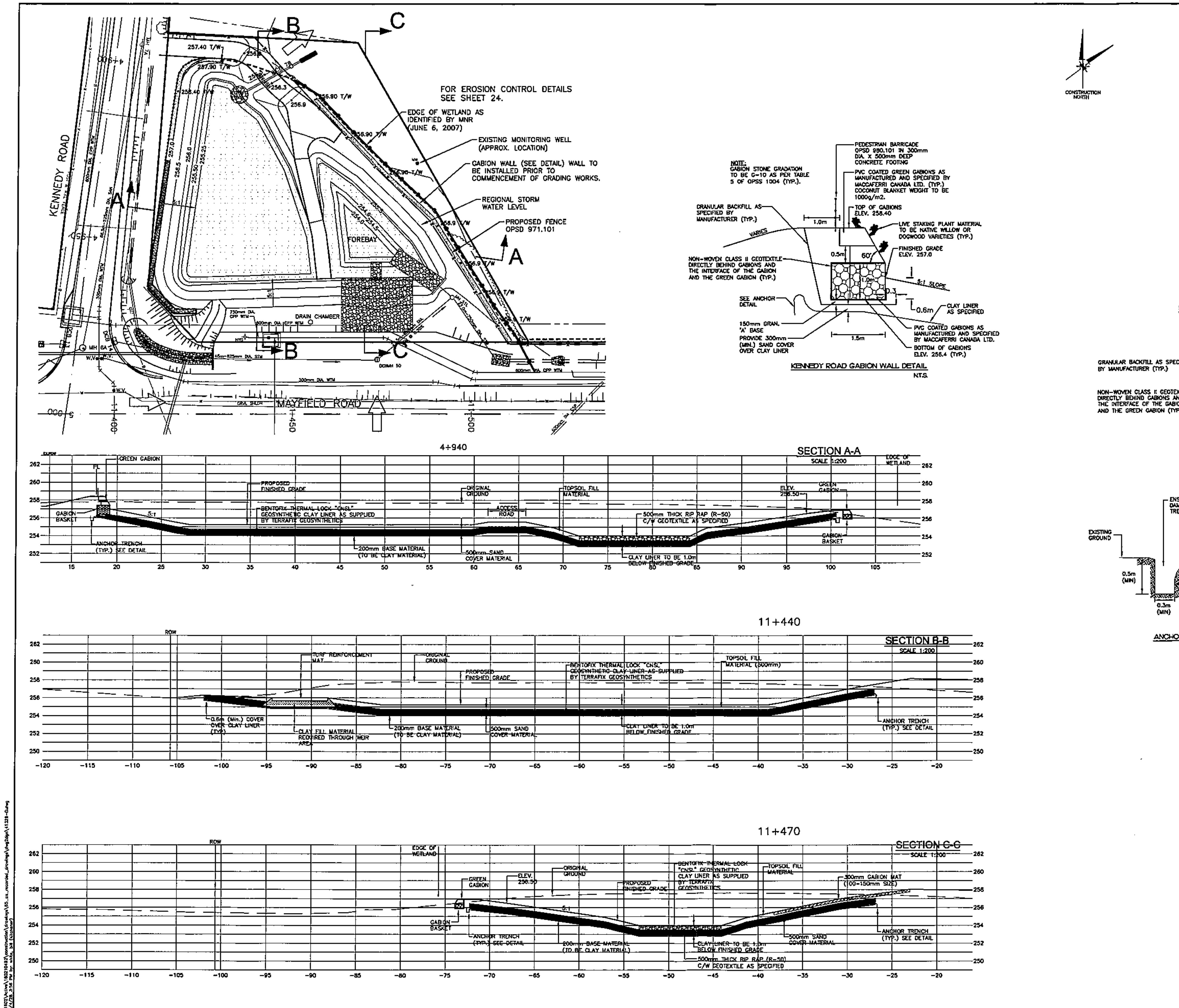
TYPICAL LIMESTONE WALKWAY
N.T.S

Stantec

Region of Peel
Working for you

MAYFIELD ROAD CONSTRUCTION
(INDER HEIGHTS DRIVE TO HEART LAKE ROAD)
LANDSCAPING
KENNEDY ROAD
SWM POND DETAILS

Lots	Area B-31	Project No. 01-4830
Checked by HTL	Drawn by DC	Plan No. 41331-D
Date Apr 28, 2011	Sheet 61 of 65	



DATE	DETAILS	INIT.
2008.06.25	RELEASED FOR TENDER	DJH
2008.08.11	ISSUED FOR CONSTRUCTION	DJH
2011.01.17	AS RECORDED	DJH

REVISIONS

LEGEND

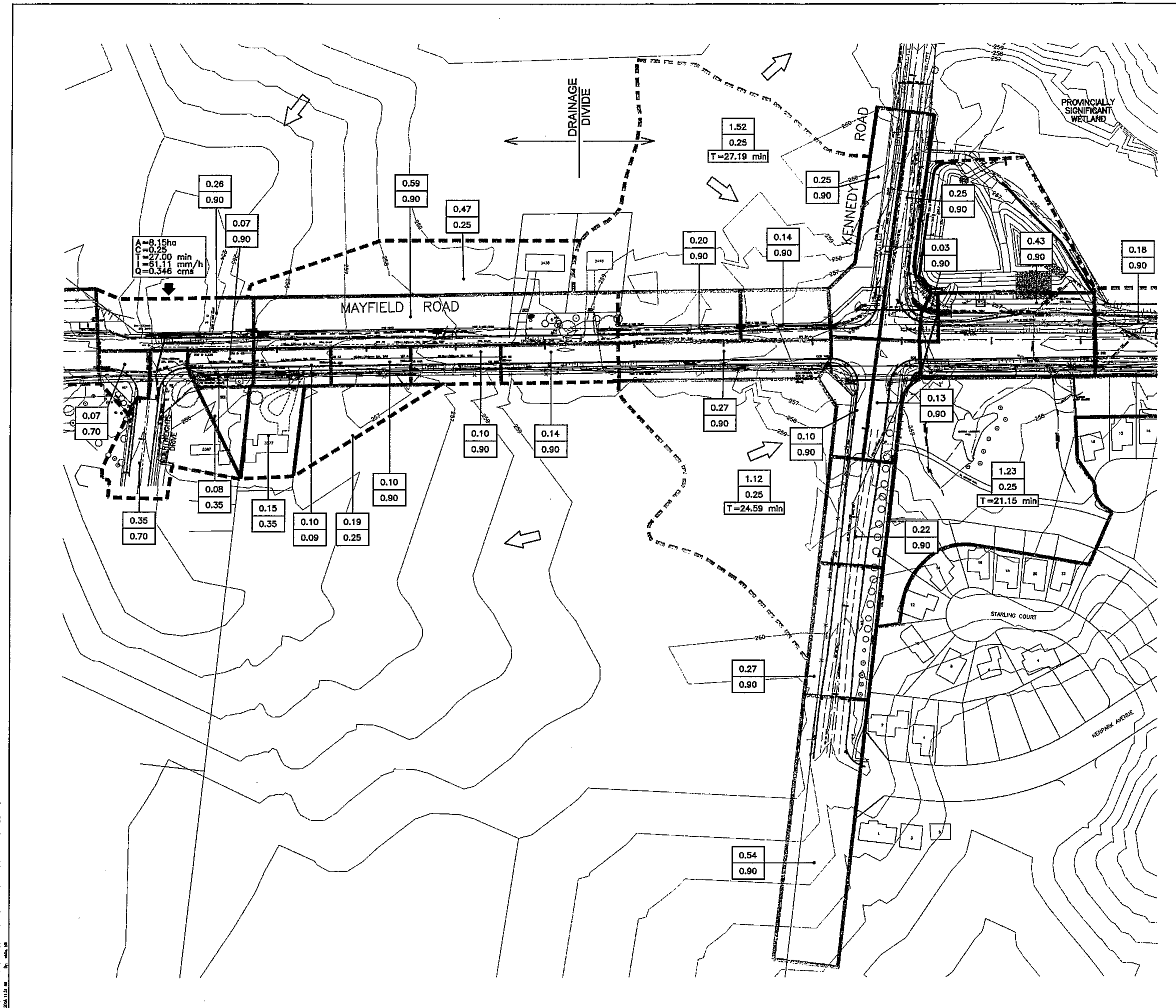
- MAJOR STORM FLOW
- +256.9 PROPOSED SPOT ELEVATION
- 259.5 PROPOSED CONTOURS
- SILT FENCE
- SHEET PILE
- EXISTING PROPERTY LINE
- ULTIMATE R.O.W.

Stantec

Region of Peel
Working for you

MAYFIELD ROAD CONSTRUCTION
(INDER HEIGHTS DRIVE TO HEART LAKE ROAD)
STORM WATER MANAGEMENT
KENNEDY ROAD SWM POND
CLAY LINER DETAILS

Lots	Area B-31	Project No.	01-4830
Checked by DH/MG	Drawn by WRW	Plan No.	41329-D
Date Mar. 25, 2011	Sheet 59 of 65		



REVISIONS		
DATE	DETAILS	INIT.
FEB. 2008	Submitted for MOE Approval	DJH

LEGEND

CB	CATCHBASIN
DCB	DOUBLE CATCHBASIN
MH	MANHOLE
CBMH	CATCHBASIN MANHOLE
FUT. MH 73.4	FUTURE STM MH INSTALLED BY OTHERS
	STORM DRAINAGE BOUNDARY
	CATCHMENT AREAS
	OVERLAND FLOW DIRECTION
0.11	STORM DRAINAGE AREA (IN HECTARES)
0.90	DRAINAGE RUNOFF COEFFICIENT

Stantec

20m 0 20 40 60m
HORIZONTAL SCALE

LICENSED PROFESSIONAL ENGINEER
D.J. HALLMAN
Jan 31/08
PROVINCE OF ONTARIO

Designed by ____ Chkd. ____ Approved by ____

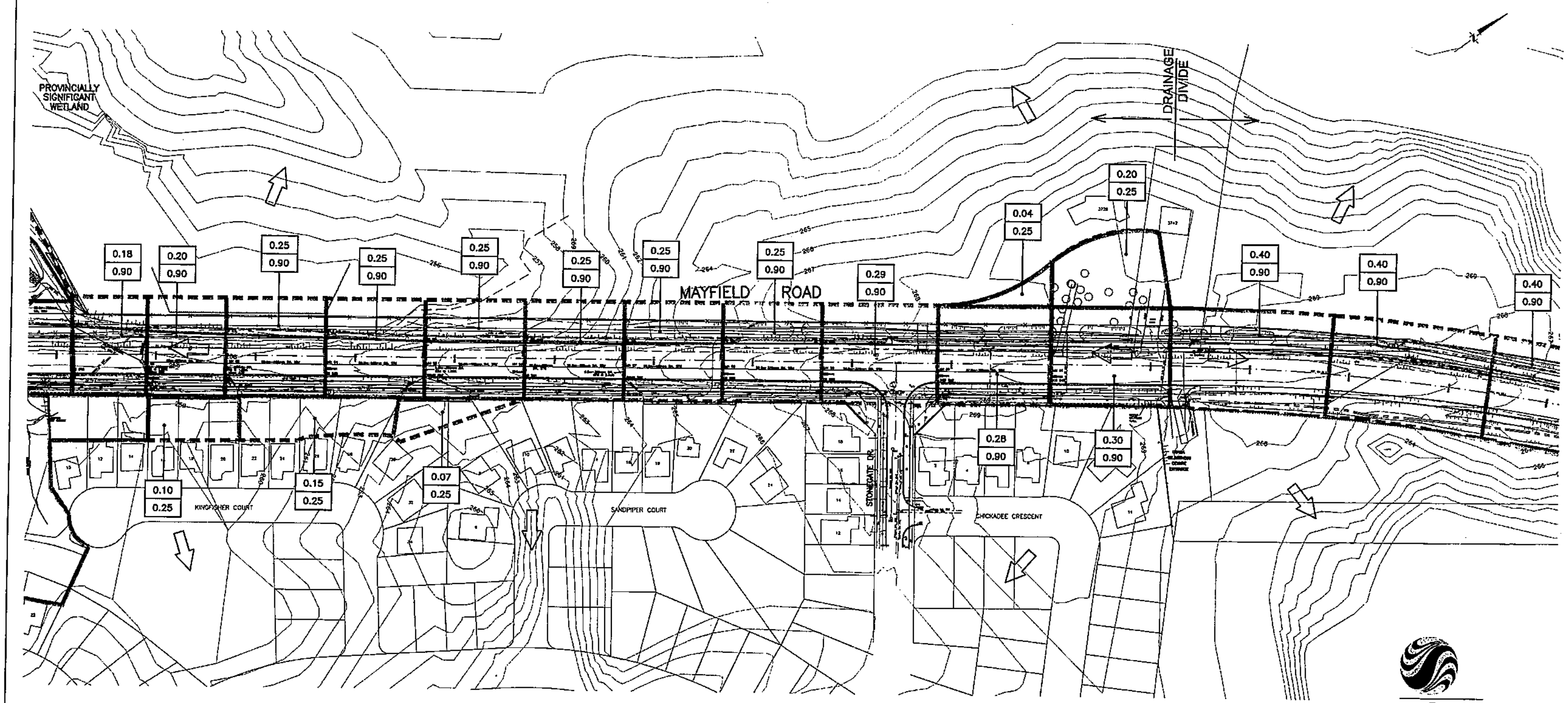
Region of Peel
Working for you

MAYFIELD ROAD RECONSTRUCTION
(INDER HEIGHTS DRIVE TO HEART LAKE ROAD)

STORM DRAINAGE PLAN
INDER HEIGHTS DRIVE TO KENNEDY ROAD

Lots	Area	Project No. 01-4830
Checked by DH/MG	Drawn by WRW	Plan No.
Date Jan. 31, 08	Sheet of 103	

REVISIONS		
DATE	DETAILS	INIT.
FEB. 2008	Submitted for MOE Approval	DJH



Stantec

20m 0 20 40 60m
HORIZONTAL SCALE

LEGEND

- CATCHBASIN
- DOUBLE CATCHBASIN
- MANHOLE
- CATCHBASIN MANHOLE
- FUTURE STM MH INSTALLED BY OTHERS
- STORM DRAINAGE BOUNDARY
- CATCHMENT AREAS
- OVERLAND FLOW DIRECTION
- 0.11 — STORM DRAINAGE AREA (IN HECTARES)
- 0.90 — DRAINAGE RUNOFF COEFFICIENT

LICENSED PROFESSIONAL ENGINEER
D.J. HALLMAN
PROVINCE OF ONTARIO

Designed by ___ Chkd. ___

Approved by ___

Region of Peel
Working for you

MAYFIELD ROAD RECONSTRUCTION
(INDER HEIGHTS DRIVE TO HEART LAKE ROAD)

STORM DRAINAGE PLAN
KENNEDY RD. – STONEGATE DR.

Lots	Area	Project No. 01-4830
Checked by DH/MG	Drawn by WRW	Plan No.
Date Jan. 31, 08	Sheet of 103	

JUN 1 2 2008

Ontario

Ministry of the Environment
Ministère de l'Environnement

CERTIFICATE OF APPROVAL
MUNICIPAL AND PRIVATE SEWAGE WORKS
NUMBER 5857-7DZPD3
Issue Date: June 6, 2008

Gary Kocialek, P.Eng.
Manager, Transportation Roads Capital
The Regional Municipality of Peel
11 Indell Lane
City of Brampton, Ontario, L6T 3Y3

Site Location: Mayfield Road at Kennedy Road
City of Brampton, Regional Municipality of Peel
L6Z 4P9

You have applied in accordance with Section 53 of the Ontario Water Resources Act for approval of:

the establishment of a stormwater management (SWM) facility to service the widening of Mayfield Road, east of Kennedy Road, for the collection, treatment and disposal of stormwater runoff from a catchment area of 10.59 hectares to provide Enhanced (Level 1) water quality protection and to attenuate post-development peak flows to pre-development levels, through a constructed wetland discharging to a Ditch Inlet Catch Basin (DICB) flowing to into the Heart Lake Wetland, then to the Etobicoke Creek with final discharge to Lake Ontario, for all storm events up to and including the 100-year AES storm, consisting of the following:

Stormwater Management System

- a constructed wetland to service the transportation expansion development located at the north east intersection of Kennedy Road and Mayfield Road, having a design permanent pool volume of 818 m^3 (first orifice elev.), an extended detention volume of 435 m^3 (second orifice elev.), a total storage volume of 3,150 m^3 for the Regional Storm event, with a proposed discharged peak flow rate from the pond of 1.431 m^3/s for the Regional Storm; with approximate triangular dimensions 27.6 m base length and 43.5 m base width and 5H:1V side slopes; complete with:

- a forebay that represents 28% of the pond surface area, with approximate triangular dimensions 9.6 m base length and 10.6 m base width and 3H:1V side slopes, designed to achieve Level 1 quality objective removing grit and sediment accumulation up to pond bottom level;

- two (2) orifice outlet pipes, the first of 95 mm diameter at invert elevation of 255.55 m to provide necessary detention for water quality purposes; and the second of 150 mm diameter at invert elevation of 255.75 m to provide control for the erosion component of extended detention;

- one (1) emergency overflow weir of 3.0 m length, located in the north side of the pond at an invert elevation of 256.30 m to direct the major flow towards the existing municipal Ditch Inlet Catch Basin;

- including erosion/sedimentation control measures during construction, which consist of: silt fencing (or equivalent) on all site boundaries where there is potential for runoff to be discharged offsite; steep slopes (>3:1) with erosion blankets; berms/swales in appropriate areas to divert flows to temporary storage locations; swales constructed onsite with temporary rock check dams to help attenuate flows and encourage deposition of suspended sediment where appropriate; erect tree protecting fencing prior to grading or construction along the outside perimeter of drip lines of preserved trees; and temporary sediment ponds (or equivalent), all with appropriate monitoring of erosion and sediment control measures particularly after rain or snow melt events; and

- all other controls and appurtenances essential for the proper operation of the aforementioned *Works* .

all in accordance with the Application for Approval of Municipal and Private Sewage Works submitted by the Region of Peel dated February 12, 2008, SWM Design Brief, drawings issued on December 2007, and addendum documents prepared by Jayson Innes, P.Eng., of Stantec Consulting Ltd.

For the purpose of this Certificate of Approval and the terms and conditions specified below, the following definitions apply:

"*Certificate* " means this entire certificate of approval document, issued in accordance with Section 53 of the Ontario Water Resources Act, and includes any schedules;

"*Director* " means any *Ministry* employee appointed by the Minister pursuant to section 5 of the Ontario Water Resources Act;

"*District Manager* " means the District Manager of the Halton-Peel District Office of the *Ministry* ;

"*Ministry* " means the Ontario Ministry of the Environment;

"*Owner* " means the Regional Municipality of Peel and includes its successors and assignees;

"*Works* " means the sewage works described in the *Owner* 's application, this *Certificate* and in the supporting documentation referred to herein, to the extent approved by this *Certificate* .

You are hereby notified that this approval is issued to you subject to the terms and conditions outlined below:

TERMS AND CONDITIONS

1. GENERAL PROVISIONS

(1) Except as otherwise provided by these Conditions, the *Owner* shall design, build, install,

operate and maintain the *Works* in accordance with the description given in this *Certificate* , the application for approval of the works and the submitted supporting documents and plans and specifications as listed in this *Certificate* .

(2) Where there is a conflict between a provision of any submitted document referred to in this *Certificate* and the Conditions of this *Certificate* , the Conditions in this *Certificate* shall take precedence, and where there is a conflict between the listed submitted documents, the document bearing the most recent date shall prevail.

(3) Where there is a conflict between the listed submitted documents, and the application, the application shall take precedence unless it is clear that the purpose of the document was to amend the application.

2. <u>EXPIRY OF APPROVAL</u>

The approval issued by this *Certificate* will cease to apply to those parts of the *Works* which have not been constructed within five (5) years of the date of this *Certificate* .

3. <u>CHANGE OF OWNER</u>

The *Owner* shall notify the *District Manager* and the *Director* , in writing, of any of the following changes within thirty (30) days of the change occurring:

(a) change of *Owner* ;

(b) change of address of the *Owner* ;

(c) change of partners where the *Owner* is or at any time becomes a partnership, and a copy of the most recent declaration filed under the <u>Business Names Act</u>, R.S.O. 1990, c.B17 shall be included in the notification to the *District Manager* ; and

(d) change of name of the corporation where the *Owner* is or at any time becomes a corporation, and a copy of the most current information filed under the <u>Corporations Information Act</u>, R.S.O. 1990, c. C39 shall be included in the notification to the *District Manager* .

4. <u>OPERATION AND MAINTENANCE</u>.

(1) The *Owner* shall inspect the *Works* at least once a year and, if necessary, clean and maintain the *Works* to prevent the excessive build-up of sediments, oil/grit and/or vegetation.

(2) The *Owner* shall maintain a logbook to record the results of these inspections and any cleaning and maintenance operations undertaken, and shall keep the logbook at Owner's Head/Administration Office and at the site for inspection by the *Ministry* . The logbook shall include the following:

(a) the name of the *Works* ; and

(b) the date and results of each inspection, maintenance and cleaning, including an estimate of the quantity of any materials removed.

5. RECORD KEEPING

The *Owner* shall retain for a minimum of five (5) years from the date of their creation, all records and information related to or resulting from the operation and maintenance including temporary sediment and erosion control measures required by this *Certificate* .

6. GENERAL SAFETY

The *Owner* shall make all necessary investigations, take all necessary steps and obtain all necessary approvals so as to ensure that the physical structure, sitting and operations of the stormwater works do not constitute a safety or health hazard to the general public.

The reasons for the imposition of these terms and conditions are as follows:

1. Condition 1 is imposed to ensure that the *Works* are built and operated in the manner in which they were described for review and upon which approval was granted. This condition is also included to emphasize the precedence of Conditions in the *Certificate* and the practice that the Approval is based on the most current document, if several conflicting documents are submitted for review.

2. Condition 2 is included to ensure that, when the *Works* are constructed, the *Works* will meet the standards that apply at the time of construction to ensure the ongoing protection of the environment..

3. Condition 3 is included to ensure that the Ministry records are kept accurate and current with respect to approved works and to ensure that subsequent owners of the works are made aware of the certificate and continue to operate the works in compliance with it.

4. Condition 4 is included to require that the *Works* be properly operated and maintained such that the environment is protected .

5. Condition 5 is included to require that all records are retained for a sufficient time period to adequately evaluate the long-term operation and maintenance of the *Works.*

6. Condition 6 is imposed because it is not in the public interest for the *Director* to approve facilities which, by reason of potential health and safety hazards do not generally comply with legal standards or approval requirements falling outside the purview of the *Ministry* .

In accordance with Section 100 of the Ontario Water Resources Act, R.S.O. 1990, Chapter 0.40, as amended, you may by written notice served upon me and the Environmental Review Tribunal within 15 days after receipt of this Notice, require a hearing by the Tribunal. Section 101 of the Ontario Water Resources Act, R.S.O. 1990, Chapter 0.40, provides that the Notice requiring the hearing shall state:

1. The portions of the approval or each term or condition in the approval in respect of which the hearing is required, and;
2. The grounds on which you intend to rely at the hearing in relation to each portion appealed.

The Notice should also include:

3. The name of the appellant;
4. The address of the appellant;
5. The Certificate of Approval number;
6. The date of the Certificate of Approval;
7. The name of the Director;
8. The municipality within which the works are located;

And the Notice should be signed and dated by the appellant.

This Notice must be served upon:

The Secretary* Environmental Review Tribunal 655 Bay Street, 15th Floor Toronto, Ontario M5G 1E5	AND	The Director Section 53, *Ontario Water Resources Act* Ministry of the Environment 2 St. Clair Avenue West, Floor 12A Toronto, Ontario M4V 1L5

* **Further information on the Environmental Review Tribunal's requirements for an appeal can be obtained directly from the Tribunal at: Tel: (416) 314-4600, Fax: (416) 314-4506 or www.ert.gov.on.ca**

The above noted sewage works are approved under Section 53 of the Ontario Water Resources Act.

DATED AT TORONTO this 6th day of June, 2008

THIS CERTIFICATE WAS MAILED
ON June 06, 2008
N.P
(Signed)

Mansoor Mahmood, P.Eng.
Director
Section 53, *Ontario Water Resources Act*

ET/
c: District Manager, MOE Halton-Peel
Jayson Innes, P. Eng., Stantec Consulting Ltd.

FEB 19 2008

Ontario

Ministry of the Environment
Ministère de l'Environnement

CERTIFICATE OF APPROVAL
MUNICIPAL AND PRIVATE SEWAGE WORKS

NUMBER 8528-7BRKWY
Issue Date: February 13, 2008

The Regional Municipality of Peel
11 Indell Lane
Brampton, Ontario
L6T 3Y3

Site Location: Mayfield Road, Kennedy Road and Heart Lake Road
Brampton City, Regional Municipality of Peel

You have applied in accordance with Section 53 of the Ontario Water Resources Act for approval of:

storm sewers to be constructed in the City of Brampton, Regional Municipality of Peel on Mayfield Road, Heart Lake Road and Kennedy Road;

all in accordance with the application from the Regional Municipality of Peel, dated February 5, 2008, including final plans and specifications prepared by Stantec Consulting Ltd.

In accordance with Section 100 of the Ontario Water Resources Act, R.S.O. 1990, Chapter 0.40, as amended, you may by written notice served upon me and the Environmental Review Tribunal within 15 days after receipt of this Notice, require a hearing by the Tribunal. Section 101 of the Ontario Water Resources Act, R.S.O. 1990, Chapter 0.40, provides that the Notice requiring the hearing shall state:

1. The portions of the approval or each term or condition in the approval in respect of which the hearing is required, and;
2. The grounds on which you intend to rely at the hearing in relation to eachportion appealed.

The Notice should also include:

3. The name of the appellant;
4. The address of the appellant;
5. The Certificate of Approval number;
6. The date of the Certificate of Approval;
7. The name of the Director;
8. The municipality within which the works are located;

And the Notice should be signed and dated by the appellant.

This Notice must be served upon:

The Secretary*
Environmental Review Tribunal
2300 Yonge St., Suite 1700
P.O. Box 2382
Toronto, Ontario
M4P 1E4

AND

The Director
Section 53, *Ontario Water Resources Act*
Ministry of the Environment
2 St. Clair Avenue West, Floor 12A
Toronto, Ontario
M4V 1L5

*** Further information on the Environmental Review Tribunal's requirements for an appeal can be obtained directly from the Tribunal at: Tel: (416) 314-4600, Fax: (416) 314-4506 or www.ert.gov.on.ca**

The above noted sewage works are approved under Section 53 of the Ontario Water Resources Act.

DATED AT TORONTO this 13th day of February, 2008

THIS CERTIFICATE WAS MAILED
ON Feb. 14, 2008
N. P
(Signed)

Zafar Bhatti

Zafar Bhatti, P.Eng.
Director
Section 53, *Ontario Water Resources Act*

NE/
c: District Manager, MOE Halton-Peel District Office
C.Gravlev, Clerk, Region of Peel
Clerk, City of Brampton
W. Won, City of Brampton
M. Goorts, Stantec Consulting Ltd.
Dave Hallman, P. Eng, Stantec Consulting Ltd. ✓

**SUPPLEMENTARY
GEOTECHNICAL INVESTIGATION
MAYFIELD ROAD WIDENING
HURONTARIO STREET TO HEART LAKE ROAD
REGION OF PEEL, ONTARIO**

Report
to

Stantec Consulting Ltd.

Steven Sather, P. Eng.
Review Principal

P. K. Chatterji, P. Eng.
Review Principal

LICENSED PROFESSIONAL ENGINEER
S. PANG
PROVINCE OF ONTARIO

Sydney Pang, P. Eng.
Project Engineer

Thurber Engineering Ltd.
Suite 103, 2010 Winston Park Drive
Oakville, Ontario L6H 5R7
Phone: (905) 829-8666
Fax: (905) 829-1166

Date: July 22, 2005
File: 17-308-292

TABLE OF CONTENTS

APPENDICES

1 INTRODUCTION

This report presents the results of a supplementary geotechnical investigation carried out by Thurber Engineering Ltd. (Thurber) at the site of the proposed widening of Mayfield Road between Hurontario Street and Heart Lake Road. This work is part of the Region of Peel Mayfield Road Reconstruction project. The supplementary investigation includes the following tasks:

- Investigation of topsoil depths in ditches and adjacent open fields along the Mayfield Road corridor from west of Hurontario Street to Valley View Drive and from Inder Heights Drive to east of Heart Lake Road.

- Geotechnical investigation/recommendations for the two storm water management (SWM) ponds proposed at Mayfield Road/Kennedy Road and at Mayfield Road/Heart Lake Road.

- Geotechnical investigation/recommendations for the proposed storm sewer crossing of Mayfield Road at Station 10+250.

- Peat investigation and probing at :
  a) southeast and southwest corners of Mayfield and Kennedy,
  b) south side of Mayfield Road at existing culvert crossing near Station 12+350 and
  c) SWM ponds and wetland areas 1(Kennedy/Mayfield), 2 (Stn. 12+350) and 3 (Mayfield/Heart Lake).

The above scope of work has been authorized by an electronic mail message from Stantec Consulting Ltd. (Stantec) to Thurber, dated March 16, 2005. This scope of work has been reduced from the original scope detailed on a request for proposal letter from Stantec dated October 28, 2004.

In addition to the above, monitoring wells were installed in both the SWM pond areas for hydrogeological study as authorized by a Stantec fax to Thurber, entitled "Mayfield Road Improvements, Additional TRCA Work" and dated May 6, 2005.

An earlier geotechnical investigation was conducted for the proposed widening of Mayfield Road which included investigation for widening of the Snelgrove Bridge over Etobicoke Creek. That investigation was reported in an earlier Thurber report dated July 24, 2003. This supplementary report should be read in conjunction with the previous July 2003 report.

The contents of this report are subject to the Statement of General Conditions attached at the end of the text. The reader's attention is specifically drawn to these conditions as it is considered essential that they be followed for the proper use and interpretation of this report.

2 SITE INVESTIGATION

The supplementary site investigation was carried out between May 16 and 20, 2005. The investigation consisted of several components:

- Hand excavated pits for assessing depth of topsoil along the corridor.
- Probing for peat/organic soil thickness at selected locations.
- Borehole investigation program at the two SWM ponds, the storm sewer crossing of Mayfield Road and at selected wetland areas. This program included installation of 50 mm diameter monitoring wells at the two SWM ponds for hydrogeology study by Stantec.

The topsoil depth investigation involved excavation of pits in ditches and adjacent open fields on both sides of Mayfield Road from Hurontario Street to Valley View Drive and from Inder Heights Drive to east of Heart Lake Road.

Peat/organic soil thickness was probed at the following locations:

- SE and SW corners of Mayfield Road and Kennedy Road. This area was not accessible to a drill rig due to ponding water and sloping ground, and was probed manually using a steel rod.

- Two SWM ponds at wetlands 1 and 3, and south side of Mayfield Road at existing culvert crossing at Stn. 12+350 within wetland 2.

The depth of probing for peat and soft soils ranged from 0.3 m to 6 m.

The borehole numbers, locations and piezometer details are summarized in the table below.

Location	Borehole Numbers	Maximum Depth below Ground Surface (m)	Piezometer/ Monitoring Well
Storm Sewer Crossing at Stn. 10+250	04-20C, 04-21	8.2, 9.8	Piezometer in BH 04-20C
SWM Pond at Mayfield/Kennedy (wetland 1)	105-05, 106-05, 05-3, 05-6, 05-7, 05-8	11.3, 11.3, 8.2, 3.7, 3.7, 3.7	Wells in BH 105-05 and 106-05
SWM pond at Mayfield/Heart Lake Road (wetland 3)	101-05, 102-05, 103-05, 104-05, 05-16	8.2, 9.8, 9.8, 9.8, 6.7	Wells in BH 101-05, 102-05, 103-05 and 104-05
South side of existing culvert, Stn. 12+350	05-10, 05-11	5.2, 5.2	-

The borehole locations and elevations were surveyed by Stantec upon completion of drilling. The boreholes where monitoring wells were installed for hydrogeological studies are numbered 101-05 to 101-06 as requested by Stantec. Drawing Nos. 17-308-292-1 to 4 show the approximate locations of the boreholes.

All borehole locations were cleared of underground utilities prior to drilling. Permission to enter the SWM pond sites were provided to Thurber by Stantec.

Track and truck mounted auger drill rigs equipped with continuous flight solid and hollow stem augers were used to advance the boreholes. Each borehole was logged and soil samples were obtained at selected intervals in conjunction with Standard Penetration Tests (SPT). Water level readings were taken on completion of drilling. The piezometers/wells were subsequently monitored on May 26 and 30, 2005. All boreholes were grouted on completion and the monitoring wells were decommissioned on May 30, 2005.

The drilling equipment was supplied and operated by DBW Drilling Ltd of Toronto, Ontario. The drilling and sampling operations were supervised on a full time basis by a member of Thurber's technical staff. Topsoil thicknesses were measured by manual excavation of shallow pits. Peat and soft/loose soil probing was carried out by manually pushing a 12 mm (0.5 in.) diameter steel rod until high resistance to further rod advance was encountered.

All samples were brought back to Thurber's laboratory for visual classification and water content determination. Selected samples were also subjected to gradation analysis.

The field drilling, sampling and laboratory testing data are summarized in the Record of Borehole sheets enclosed in Appendix A. The geotechnical laboratory test results are included in Appendix B.

3 SUBSURFACE CONDITIONS

Details of the subsurface conditions encountered at each borehole are presented in the Record of Borehole Sheets attached in Appendix A. A general description and summary of the stratigraphy is given in the following paragraphs. The detailed information provided in the records of boreholes takes precedence to this general description of site conditions. Subsurface conditions will vary between and beyond borehole locations.

3.1 Topsoil Depths

Topsoil depths noted along the Mayfield Road corridor from west of Hurontario Street to Valley View Drive and from Inder Heights Drive to east of Heart Lake Road are tabulated in Table A1 in Appendix A. The test pit data indicates that the topsoil depths range from 0 to 600 mm. The data also shows that at an offset of 4 to 15 m from the centreline of the proposed widened road the topsoil thickness generally ranges from 0 to 100 mm. However thicker topsoil ranging from 150 to 600 mm was encountered at greater offsets (15 to 27 m) from the proposed centreline.

It should be recognized that thicker deposits of topsoil may be present at locations between and beyond the hand pit locations particularly where old streambed/drainage channels, farm fields and poorly drained areas exist.

3.2 Peat/Organic/Very Soft Soil Deposits

The probe results of the peat/organic/very soft soil deposit in swampy areas are summarized below. It should be noted that the depths reported below are the depths to which a 12 mm (0.5 in.) diameter probe rod could be pushed by moderate manual effort. Since no samples were retrieved, the probe depth is an initial estimation of the approximate depth of peat, organic and very soft/loose soils.

Location of Peat/Organic/ Soft Soil Area	Approximate Plan Area of Peat/Organic/ Very Soft Soil Deposit	Probe Number	Approximate Depth of Peat/Organics/ Soft Soils at Locations Probed	Approximate Depth of Water Above Peat/Organics at Locations Probed
SW Corner of Mayfield/Kennedy	50 m X 4 m	P1 P2	P1 = 3.0 m P2 = 3.7 m	P1 = 0.2 m P2 = 0 m (water at surface)
SE Corner of Mayfield/Kennedy	30 m X 25 m with additional 15 m X 4 m in ditch	P3 P4	P3 = 3.7 m P4 = 2.5 m	P3 = 0.5 m P4 = 0.5 m
NW Corner of Mayfield/Heart Lake	70 m X 4 m	P5 P6 P7	P5 = 0.6 m P6 = 2.5 m P7 = 2.1 m	P5 = 0 m P6 = 0 m P7 = 0 m (water at surface)
SW Corner of Mayfield/Heart Lake (SWM Pond 2)	65 m X 30 m	P8 P9 P10 P11 P12 P13 P14 P15	P8 = 1.4 m P9 = 2.7 m P10 = 2.5 m P11 = 4.6 m P12 = 1.7 m P13 = 4.6 m P14 = 2.7 m P15 = 1.1 m	P8 = 0.15 m P9 = 0.6 m P10 = 0.6 m P11 = 0.3 m P12 = 0.15 m P13 = 0.3 m P14 = 0.3 m P15 = 0.15 m
NE Corner of Mayfield/Kennedy (SWM Pond 1) Ditch south of SWM Pond 1	100 m X 3 m	P16 P17 P18	P16 = 1.5 m P17 = 1.2 m P18 = 0.3 m	P16 = 0 m P17 = 0 m P18 = 0 m (water at surface)
NE Corner of Mayfield/Kennedy (SWM Pond 1) Ditch east of SWM Pond 1 along south edge of Provincially Significant Wetland	200 m long	P19 P20 P25 P26 P27	P19 = 0.6 m P20 = 6.0 m P25 = 3.0 m P26 = 1.2 m P27 = 4.3 m	P19 = 0 m (water at surface) P20 = 0.15 m P25 = 0.3 m P26 = 0.3 m P27 = 0.3 m
NE Corner of Mayfield/Kennedy (SWM Pond 1) Edge of Provincially Significant Wetland on NE side of SWM Pond 1	130 m long	P21 P22 P23 P24	P21 = 3.2 m P22 = 1.8 m P23 = 3.4 m P24 = 4.0 m	P21 = 0.15 m P22 = 0.3 m P23 = 0.3 m P24 = 0.3 m

It should be recognized that greater thicknesses of peat, organics and very soft/loose soils may be encountered during excavation than that determined by probing.

3.3 Storm Sewer Crossing at Stn 10+250 (BH 04-20C and 04-21)

BH 04-20C was drilled near the north toe of the existing Mayfield Road embankment, while BH 04-21 was drilled through the south shoulder of the existing road near the proposed crossing location.

BH 04-20C indicates a stratigraphy of 170 mm of topsoil underlain by about 1.4 m of firm to stiff clayey silt (SPT blow count of 6 to 9). A deposit of dense to very dense (SPT blow count of 48 to over 50) silt and sand with occasional cobbles and boulders and 0.3 m thick wet sand layers was encountered below the upper clayey silt. Below about 5.8 m depth, hard (SPT blow counts of 84 and 48) clayey silt till with occasional sand layers was encountered to the end of the borehole.

Figure B1 shows grain size distribution curves of samples of this clayey silt till including one sample obtained from Borehole 05-20C.

The water content of the surficial clayey silt layer ranged from 20 to 30% and in the underlying silt and sand layer, the water content ranged from 9 to 12%. The water content of the lower till ranged from 9 to 19%.

BH 04-21 drilled through the road shoulder encountered 125 mm of asphalt over 640 mm of sand and gravel (pavement structure). This was underlain by about 3 m of road embankment fill consisting primarily of sandy to clayey silt with a 0.3 m layer of dense sand and gravel fill. Below the road embankment, a 1.2 m layer of dense to compact gravelly sand was noted which was underlain by a sequence of stiff to dense clayey silt to sandy silt till to a depth of 8.7 m. Below 8.7 m, a layer of dense silty sand was encountered to the end of the borehole.

Although not directly encountered in the boreholes, the glacial tills inherently contain cobbles and boulders.

Figures B3 and B4 show the grain size distribution curves of samples of the sandy silt and silty sand, respectively.

The water content in the road fill ranged from 2 to 16% and in the native soils from 9 to 29%.

The water level in the piezometer installed in BH 04-20C indicated a water level at about 6 m depth (Elev. 243.5).

3.4 Storm Water Pond at Kennedy/Mayfield (BH 105-05, 106-05, 05-3, 6, 7 and 8)

BH 105-05, 106-05 and 05-3 were drilled in the storm pond area and BH 05-6, 05-7 and 05-8 were drilled along the proposed access road on the east side of the pond.

About 1 m of topsoil and peat was encountered in BH 05-3 drilled near the southwest corner of the proposed pond (see Dwg. 17-308-292-2). Peat ranging in thickness from 0.5 to 1.1 m was also encountered in BH 05-6, 05-7 and 05-8 drilled along the east side of the pond. The peat was mixed with silt and clay and was noted to be very soft and loose. Standing water was encountered in some areas. The water content of the peat/organic soils ranged from 25 to 75%.

No peat was encountered in BH 105-05 and 06; however 150 mm of topsoil was encountered in these two boreholes.

For the boreholes drilled in the pond area (105-05 and 106-05), the stratigraphy below the topsoil and peat consisted of a sequence of clayey silt till overlying sand to sandy silt. These native deposits are firm and compact near the surface and becomes dense or stiff, and occasionally very dense or hard, below a depth of about 2 m. The water content of the deposits ranges from a low of 4% to a high of about 20%.

The gradation of two samples of the clayey silt till from BH 105-05 and 106-05 are shown on Figure B2. The gradation of samples of the sandy silt, silty sand and sand are shown on Figures B3, B4 and B5.

In BH 05-6, 05-7 and 05-8 drilled along the east access road, the peat is underlain by a deposit of firm to very stiff grey clayey silt till. The water content in the samples ranges from 10 to 19%.

Although not directly encountered in the boreholes, the glacial tills inherently contain cobbles and boulders.

The peat and standing water indicate shallow groundwater at the surface.

The monitoring wells installed at about 11 m depths in BH 105-05 and 105-06 indicated a water level of 9.4 to 9.5 m below ground surface (Elev. 248.2). The water level is BH 05-6, 05-7 and 05-8 were noted to be at the surface to 2.4 m below surface at the completion of drilling. These observations are very short term and water table may rise with time or fluctuate with seasonal condition.

3.5 Storm Water Pond at Mayfield/Heart Lake Road (BH 101-05, 102-05, 103-05, 104-05, and 05-16)

The boreholes drilled within the swampy area at this storm pond location indicate 530 mm to 840 mm of loose topsoil/organics in BH 101-05 and 05-16. The other three boreholes located south of the swampy area (102-05, 103-05 and 104-05) encountered thinner topsoil of 0.15 m to 0.3 m in thickness. The water content of samples from the topsoil/organics layer range from 28 to 75%.

Underlying the topsoil, the soils consist of a sequence of silty clay to clayey silt till. Layers of non-plastic silt and sandy silt were encountered at 7.2m depth in BH 102-05 and at 7.6 m depth in BH 104-05. The till layer has a stiff to hard consistency. Grinding of augers was noted at varying depths in several boreholes (BH 102-05, 103-05 and 104-05) indicating the presence of gravel, cobbles or boulders.

Although not directly encountered in the boreholes, the glacial tills inherently contain cobbles and boulders.

Figure B1 shows the grain size distribution curves of selected samples of this till.

The water content of the silty clay to clayey silt till ranges from 12 to 18%.

Monitoring wells installed in selected boreholes (101-05, 102-05, 103-05 and 104-05) indicate ground water level at 5.5 to 7.5 m below ground surface (approximate elev. ranging from 252.4 to 256.1 m). These are short term observations and the water level may fluctuate with time and seasonal conditions.

3.6 South Side of Culvert Crossing near Stn 12+350 (BH 05-10 and 05-11)

BH 05-10 encountered 80 mm of topsoil which was underlain by firm to stiff clayey silt till.

BH 05-11 on the east side encountered 130 mm of topsoil overlying about 1.4 m of soft clayey silt fill. Below the fill, soft peat containing wood fragments was encountered to 3.35 m depth. The water content of the peat ranged from 59 to 150%. Very loose to compact wet sandy silt was encountered below the peat.

The groundwater level in BH 05-11 was noted at 2.4 m depth on completion of drilling.

4 GEOTECHNICAL EVALUATION AND RECOMMENDATIONS

4.1 Topsoil Depths

Topsoil depths noted along the Mayfield Road corridor from west of Hurontario Street to Valley View Drive and from Inder Heights Drive to east of Heart Lake Road are presented in Table A1 in Appendix A. It should be noted that thicker deposits of topsoil may be present at locations between and beyond the locations explored, along old streambed/drainage channels, in farm fields and in poorly drained areas.

4.2 Peat/Soft Soil Areas

4.2.1 Mayfield Road and Kennedy Road

The extent of peat and very soft/loose soils was assessed using hand probing methods. The boundaries and inferred depths of peat/organics are therefore approximate. Drawing No. 17-308-292-2 shows the approximate locations of the hand probes near the above intersection. The depths at which resistance was encountered are tabulated in Section 3.2. The probing data indicates the following:

Location	Approximate Depth of Peat/Very Soft Soils at Locations Probed
SW Corner	3 to 3.7 m
SE Corner	2.5 to 3.7 m
N of Mayfield Rd (approx. Stn 11+400 to 11+ 510)	0.3 to 1.5 m
N of Mayfield Rd (approx. Stn 11+530 to 11+ 650)	0.6 to 6 m

It is understood that the existing Mayfield Road pavement near the SE and SW corners has suffered settlement in the past requiring pavement padding which is consistent with peat/soft soils noted at these locations.

Anecdotal information also indicates that the light standard near Probe P4 had to be founded at a deeper depth on firmer soils.

For widening of Mayfield Road, widened embankments will need to be constructed in the swampy areas in the SE and SW corners.

Subexcavation

All standing water should be drained from these swampy areas and all peat/organics/soft soils should be removed from the footprint of the new embankment. The extent and depth of subexcavation of peat/soft soil should be confirmed in the field by visual examination. Care should be exercised not to undermine or destabilize the existing Mayfield Road embankment while subexcavating peat and soft soils adjacent to the toe of the embankment. Shoring (roadway protection) may be required especially if the existing embankment is resting on peat. Attempts should be made to maintain a reasonably dry excavation. The subgrade after removal of peat/soft soils should be inspected by geotechnical personnel. Once the subgrade is inspected and approved, embankment fill may then be placed. Depending on the conditions of the final subgrade, use of geotextile or geogrid (to be placed immediately below base level of embankment) may be warranted and the contract should allow for this possibility.

Embankment

- Rock fill (crushed limestone of rip-rap size, but not shale) should be used to backfill the swamp subexcavation. Once the fill is above the swamp level, the upper surface should be chinked, and a geotextile should be used to cover the rock fill after which a 150 mm layer of Granular B Type II should be placed on the geotextile. The Granular B and the geotextile are required to minimize loss of earth into the underlying rock fill.

- Inorganic earth embankment fill may then be placed in 150 mm lifts above the 150 mm granular layer to construct the remainder of the road embankment for widening. Each lift should be compacted to 98% of SPMDD at +/- 2% of optimum moisture content.

- Where new fill is being placed against old embankment fill, all topsoil and organics should be stripped from the old embankment slope and the old fill slope should be benched as per OPSD 208.010 prior to receiving new fill. All fill slopes should be provided with erosion protection.

4.2.2 Mayfield Road / Heart Lake Road

Drawing No. 17-308-292-4 shows the very approximate areal extent of the peat/soft soil deposits at this intersection. The probing data indicates the following approximate depth of subexcavation:

Location	Approximate Depth of Peat/Very Soft Soils at Locations Probed
NW Corner	0.6 to 2.5 m
SW Corner	1.1 to 4.6 m

At the southwest quadrant, the thickness of peat/soft soil deposits in the area of road embankment widening ranges from 1.1 m to 4.6 m. It is recommended that all peat and soft soils under the embankment widening in this area be removed. Geotechnical/construction recommendations provided for dealing with the peat/soft soils at the

Mayfield/Kennedy intersection in the previous section are applicable at this intersection as well.

In areas with deep peat/soft soil deposits, it is advisable to subexcavate all such soft deposits to avoid future uneven settlement of the roadway. Field inspection should be carried out during subexcavation to confirm that firm subgrade has been reached prior to placing any fill. Depending on the condition of the subgrade, use of geotextile and geogrid (to be placed immediately below base level of embankment) may be warranted and the contract should allow for this possibility.

4.2.3 Culvert Crossing at Stn 12 + 350

BHs 05-10 and 11 were drilled on the south side of Mayfield Road at this location. A peat layer was noted below the fill in BH 05-11. The peat layer is 1.9 m thick and was encountered at a depth of 1.5 m extending to 3.4 m. The sandy silt soils below the peat is also in a very loose state to a depth of about 4.5 m. For embankment widening in this area, the peat should be removed prior to construction of new embankment to minimize the future possibility of settlement of the road.

4.2.4 Pavement Design in Wetland / Swampy Areas

Thurber's original geotechnical report of July 24, 2003 provided pavement design recommendations for the road widening. For areas where the peat or soft soils is not completely removed or is only partly removed and where geogrid is used to cross the swampy subgrade, the pavement thickness should be increased to allow for softer subgrade condition.

As recommended in our July 24, 2003 report, the pavement design in such areas should be as follows:

Material	Thickness (mm)
HL-1	40
HDBC	100
Granular A Base	200
Granular B Type II Subbase	900

All Granular A and B courses should be compacted to 100% of SPMDD at +/- 2% of optimum moisture content. All asphalt should be compacted to 97% of 75 blow Marshall Density or to Region of Peel Specifications.

4.3 Storm Sewer Crossing at Stn 10+250

It is understood that consideration is being given to employing trenchless excavation methods for installing a storm sewer underneath the embankment of Mayfield Road at Station 10+250. The location of the proposed sewer crossing is shown on Drawing No. 17-308-292-1. The total length of trenchless excavation will be approximately 35 m to 40 m, assuming that the work is to be carried out before the road widening. Information provided by Stantec indicates that the storm sewer pipe to be installed under the road will be 600 mm in diameter, and will connect two maintenance hole structures, MH13L and MH13R, near the north and south limits of the road crossing, respectively. The invert of the pipe will be at approximate Elevations 247.1 m and 246.7 m for the north and south limits, respectively. The proposed final road grade is at approximately Elevation 252.9 m, resulting in a crown cover in order of 5 m above the pipe.

Based on the results of Boreholes 04-20C and 04-21, the proposed pipe will be installed predominantly within non-plastic very dense sands and silts with occasional cobbles, boulders and wet sand layers, and low plastic, stiff clayey silt till. Perched water tables are anticipated to be present within the existing road fill and the native soils within tunnelling depths.

Due to the anticipated low "stand-up" time and potential of loss of ground at the face of the excavation associated with cohesionless sands and silts and the potential of encountering cobbles and boulders within the glacially derived soils, conventional jack-and-bore techniques are not recommended at this site. Pipe jacking advanced with a closed face tunnel boring machine, such as Earth Pressure Balance (EPB) machines, is typically not cost-effective for short tunnels, and is therefore not recommended for this project.

Consideration may be given to the following trenchless methods:

- Method 1 - Conventional tunnelling techniques involving hand-mining.
- Method 2 - Pipe ramming.

Method 1 would require a larger excavation (1.5 m to 1.8 m diameter) for access of personnel and equipment. Seepage control and boulder removal procedures are likely required. Diversion of surface water from the tunnel area is also necessary.

Method 2 is generally considered feasible, but requires procedures for handling and removing obstructions. Reinforcement of the cutting head with bevelled cutting shoes will likely be required.

It is recommended that the tunnel boring be carried out in advance of the road widening and reconstruction.

In order to confirm that the tunnelling processes do not have adverse effects on the Mayfield Road embankment, it is recommended that a monitoring program be carried out as outlined in the following:

- Carry out pre-construction condition survey of the existing roadway and existing buried utilities in the vicinity of the proposed tunnel alignment, including documentation of the existing pavement surface condition, cracks and depressions, and survey of the integrity of buried utilities. If necessary, adjacent utilities may have to be temporarily supported and/or relocated.
- Implement an instrumentation and monitoring program that should include precision levelling, or total station, survey of settlement points located along and adjacent to the tunnel alignment, visual monitoring of the roadway including the identification of items such as opening of old and development of new cracks, potential development of sink holes.
- Carry out post-construction condition survey of the roadway and adjacent utilities.

The trenchless methods require construction of pits at either end of the tunnel. The starting and receiving pits are expected to be formed by excavating mainly through stiff clayey silt till or dense sands and silts. Temporary shoring system such as a braced soldier pile and lagging wall will be required as roadway protection. Pre-augering may be required to socket the soldier piles into the underlying hard till. Measures should be in place to provide control of seepage from perched water tables. Surface water should be diverted away from the pits at all times.

Decisions regarding shoring methods and construction sequencing should be made by the contractor. Any required shoring system must be designed by a licensed Professional Engineer.

4.4 Storm Water Management Facility (Wetland 1 - Kennedy and Mayfield)

Consideration is being given to constructing a storm water management facility, SWM 1, at the northeast quadrant of Kennedy Road and Mayfield Road. Information provided by Stantec indicates that this facility consists of a west pond and an east pond. An access road will run in a north-south direction between the two ponds, and a maintenance road will form the north and east boundaries of the facility.

The base of both ponds is triangular in shape. The base of the west pond is designed to be at approximate Elevation 255.2 m, with a side slope inclination of 5 H to 1 V at its west boundary with Kennedy Road, and at its south boundary with Mayfield Road. The base of the east pond is designed to be at approximate Elevation 254.0 m, with a side slope inclination of 5 H to 1 V at its south boundary with Mayfield Road. The remaining slopes of the ponds have inclinations varying between 5H to 1 V and 3H to 1V.

SWM 1 will be formed as a cut into predominantly low plastic, stiff to very stiff clayey silt till overlying compact to very dense sands and silts. Perched water tables are anticipated to be present within the wet sand layers in the cohesive soils and in areas covered by surficial peat/organics.

Stability of the proposed side slope configurations have been analysed using available subsurface data. The commercially available slope stability program GSLOPE developed by Mitre Software Inc. was used to assess the cut stability. Short term (undrained) and long term (drained) conditions, as well as the case of "rapid drawdown" (a situation where the water level in the pond dropped abruptly, resulting in saturated side slopes) were included in the analyses.

Results of stability analyses carried out for the proposed cut slopes indicate that adequate Factors of Safety (F.S.) can be maintained for global stability at this SWM 1 site. The estimated F.S. at selected locations are summarized in the following table:

SWM1 Stability Analysis Results

Location	Type of Analysis	F.S.
West pond (west slope bordering Kennedy Road)	Short Term (Undrained)	> 2
	Long Term (Drained)	> 2
	Rapid Drawdown	1.7
East pond (east slope)	Short Term (Undrained)	> 2
	Long Term (Drained)	1.7
	Rapid Drawdown	1.35
East pond (south slope bordering Mayfield Road)	Short Term (Undrained)	> 2
	Long Term (Drained)	> 2
	Rapid Drawdown	1.35 (lower slope) 1.7 (overall slope)

Figures C1 to C4 present selected stability analyses results for the critical cases of rapid drawdown at this site. The soil properties assumed in the analyses are shown on these figures.

Construction of the SWM ponds will require excavation predominantly through stiff clayey silt till and compact to dense sands and silts. Subexcavation and backfilling will be required to construct to final grade. Glacial till deposits inherently contain cobbles and boulders. The north and south boundaries of SWM 1 will encounter peat/organics. The peat/organics should be sub-excavated to expose native soils and the sub-excavation backfilled with the excavated clayey silt till available on site.

The maintenance road subgrade should be sloped at a 3% and be proof-rolled to delineate loose/soft areas that should be sub-excavated and backfilled with suitable compacted fill. All road fill should be placed in loose lifts of not more than 200 mm thick and compacted to 98% of its SPMDD within ±2% of the OMC. The road should be surfaced with a 400mm layer of Granular B Type II for wet weather access.

Existing borehole information indicates that the stiff clayey silt till will be exposed across the base of the east pond. This soil will have a relatively low hydraulic conductivity and the infiltration/exfiltration rates are therefore expected to be very low during periods of high precipitation. At the west pond, however, the sands and silts will be exposed at some locations. These soils will have higher hydraulic conductivities. Since the base of the pond will be above the seasonal groundwater levels, the pond may become dry during periods of low inflow.

Should it be necessary to maintain a head of water in the pond due to hydrologic and/or other reasons, consideration may be given to installing a compacted clay liner in areas where the sands and silts are exposed at the base of the pond. A typical clay liner would be approximately 0.5 m in thickness. Excavated clayey silt till materials from the cut may be used to form the liner.

The cut slope surfaces should be provided with erosion protection such as hydroseeding and vegetation, and rip-rap in areas of high velocity or concentrated water flow. Reference may be made to OPSS 572 and related special provsions.

4.5 Storm Water Management Facility (Wetland 3 – Heart Lake and Mayfield)

Consideration is being given to constructing a storm water management facility, SWM 2, at the southwest quadrant of Heart Lake Road and Mayfield Road. Information provided by Stantec indicates that this facility consists of a west pond and an east pond. An access road will run in a north-south direction between the two ponds, and a maintenance road will form the south boundary of the facility.

The base of both ponds is irregularly shaped. The base of the east pond is designed to be at approximate Elevation 258.7 m, with a side slope inclination of 5H to 1V (lower slope) and 3H : 1V (upper slope) at its east boundary with Heart Lake Road and at its north boundary with Mayfield Road. The base of the west pond is designed to be at approximate Elevation 257.5 m, with south and west side slope inclinations ranging between 5H to 1V and 3H to 1V.

SWM 2 will be formed as a cut into predominantly low plastic, stiff to hard clayey silt till overlying compact to very dense sandy silt to silt. Peat to 4.6 m depth was found overlying the till at locations along the north boundary of the east pond where surface ponding water is present. Perched groundwater is anticipated to be present within the native soils.

Stability of the proposed side slope configurations have been analysed using available subsurface data. The analyses assume that all peat has been subexcavated and replaced with compacted earth fill.

Results of stability analyses carried out for the proposed cut slopes indicate that adequate F.S. can be maintained for global stability at this site. The estimated F.S. at selected locations are summarized in the following table:

SWM2 Stability Analysis Results

Location	Type of Analysis	F.S.
East pond (north slope bordering Mayfield Road)	Short Term (Undrained)	> 2
	Long Term (Drained)	> 2
	Rapid Drawdown	1.4
East pond (east slope bordering Heart Lake Road)	Short Term (Undrained)	> 2
	Long Term (Drained)	> 2
	Rapid Drawdown	1.3

East pond (south slope)	Short Term (Undrained)	> 2
	Long Term (Drained)	> 2
	Rapid Drawdown	1.35 (upper slope) 1.65 (overall slope)

Figures C5 to C8 present selected stability analyses results for the critical cases of rapid drawdown at this site. The soil properties assumed in the analyses are shown on these figures.

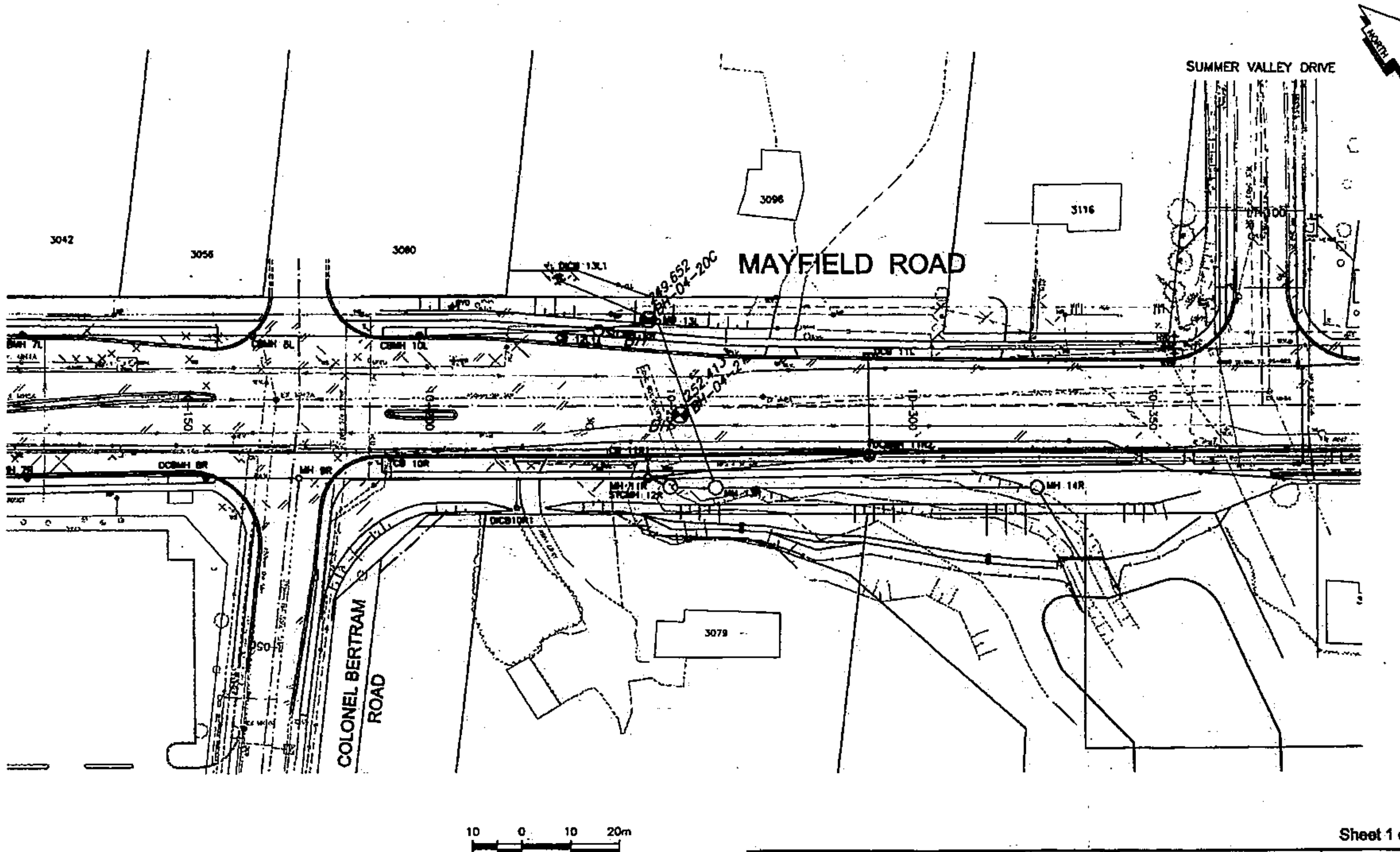
Construction of the SWM ponds will require excavation through stiff to occasionally hard clayey silt till. Care should be exercised when excavating within the road widening areas where surficial peat/organics are required to be subexcavated. Along the proposed north pond boundary with Mayfield Road where peat underlies the existing road embankment, shoring will be required as roadway protection to allow peat removal. Traffic detour will be required if peat removal is to be carried out under the existing embankment.

Any required temporary shoring systems for supporting the road embankments must be designed by a Professional Engineer experienced in such designs.

Existing borehole information indicates that the stiff to hard clayey silt till will be exposed across the base of both ponds. This soil has relatively low hydraulic conductivity and therefore infiltration is expected to be very low from the base of the pond. However, on the fill slopes adjacent to the new Mayfield Road widened embankment, a compacted clay liner may be installed should it be necessary to maintain a head of water in the pond.

Both the access and the maintenance roads will be constructed on stiff clayey silt subgrade. The road subgrade should be sloped at 3% and be proof-rolled to delineate loose/soft areas that should be sub-excavated and backfilled with suitable compacted fill. All road fill should be placed in loose lifts of not more than 200 mm thick and compacted to 98% of its SPMDD within ±2% of the OMC. The road should be surfaced with a 400mm layer of Granular B Type II for wet weather access.

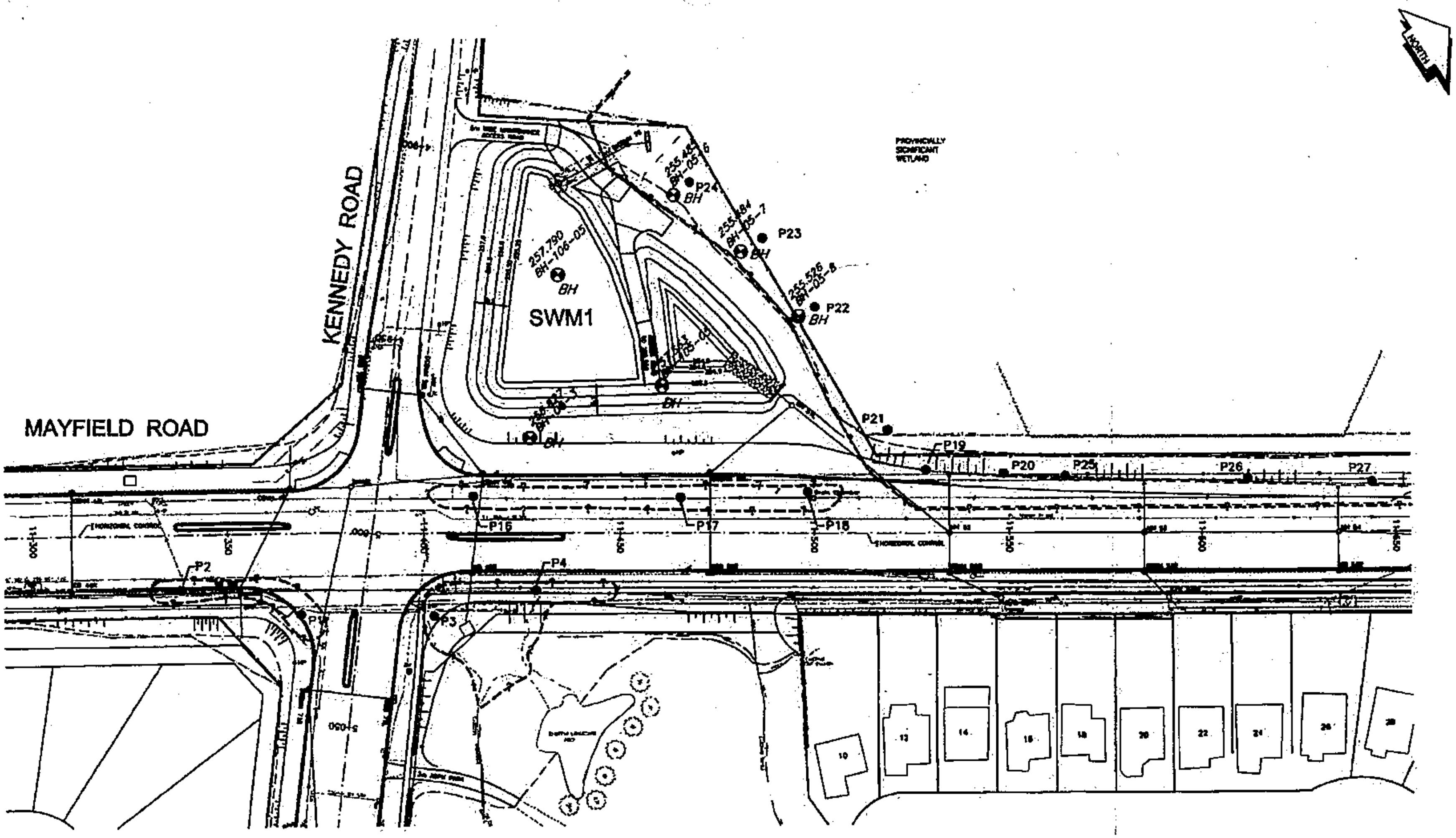
The cut slope surfaces should be provided with erosion protection such as hydroseeding and vegetation, and rip-rap in high velocity or concentrated flow areas. Reference may be made to OPSS 572 and related special provsions.



Sheet 1 of 4

ENGINEER MF	Stantec	THURBER
DRAWN SS	Geotechnical Investigation	
DATE JUNE, 2005	Mayfield Road Widening	
APPROVED PKC	STORM SEWER CROSSING AT STN.10+250	DRAWING NO. 17-308-292-1
SCALE 1:800	BOREHOLE LOCATION PLAN	

JUNE , 2005
TED08292-1.DWG



LEGEND:

- BOREHOLE
- PEAT/SOFT SOIL PROBE LOCATION
- VERY APPROXIMATE EXTENT OF PEAT/SOFT DEPOSIT

10 0 10 20m

Sheet 2 of 4

ENGINEER	MF
DRAWN	SS
DATE	JUNE, 2005
APPROVED	PKC
SCALE	1:1000

Stantec

Geotechnical Investigation

Mayfield Road Widening

SWM POND AT MAYFIELD/KENNEDY

BOREHOLE LOCATION PLAN

THURBER

DRAWING NO. 17-308-292-2

JUNE, 2005

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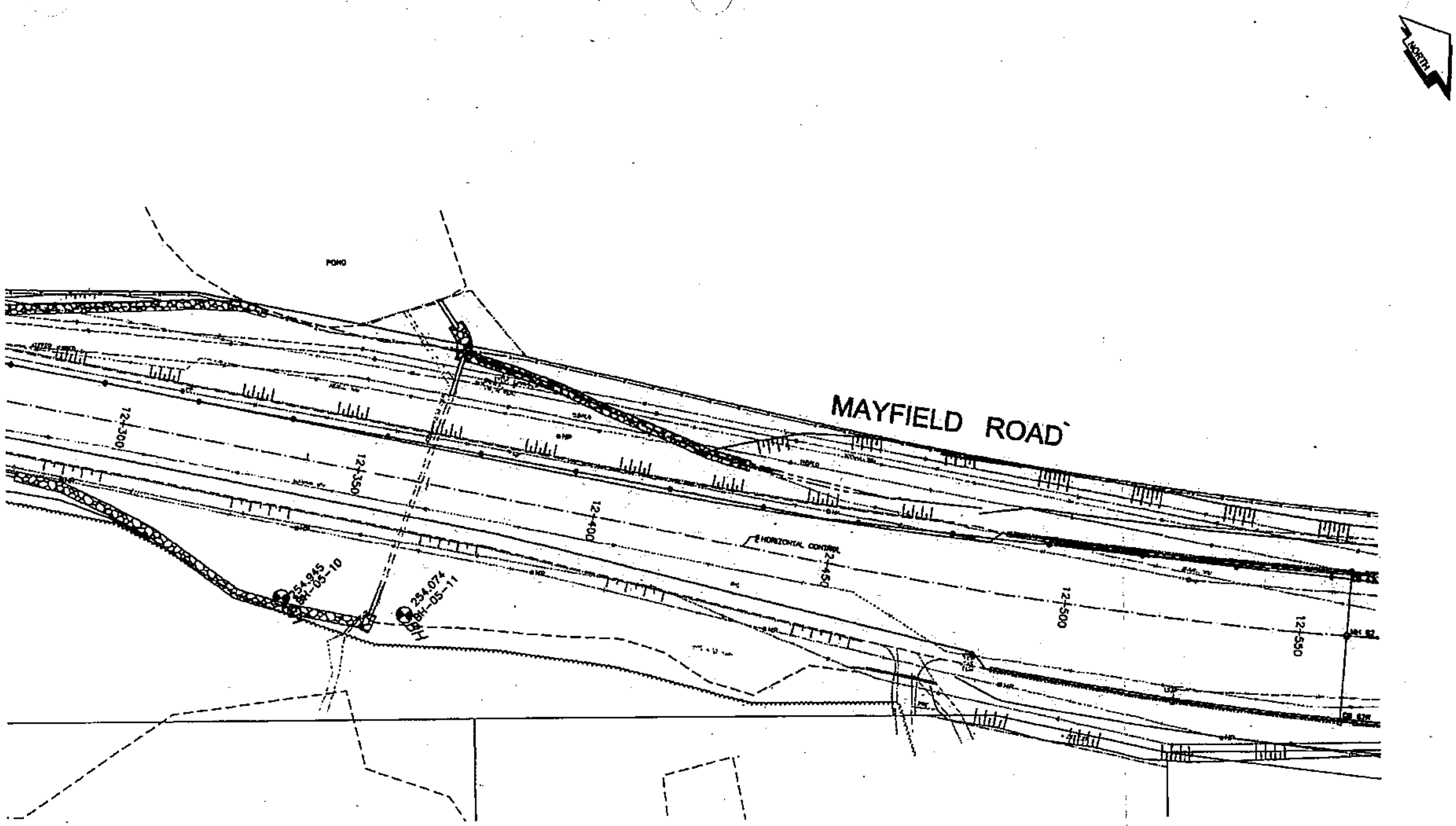
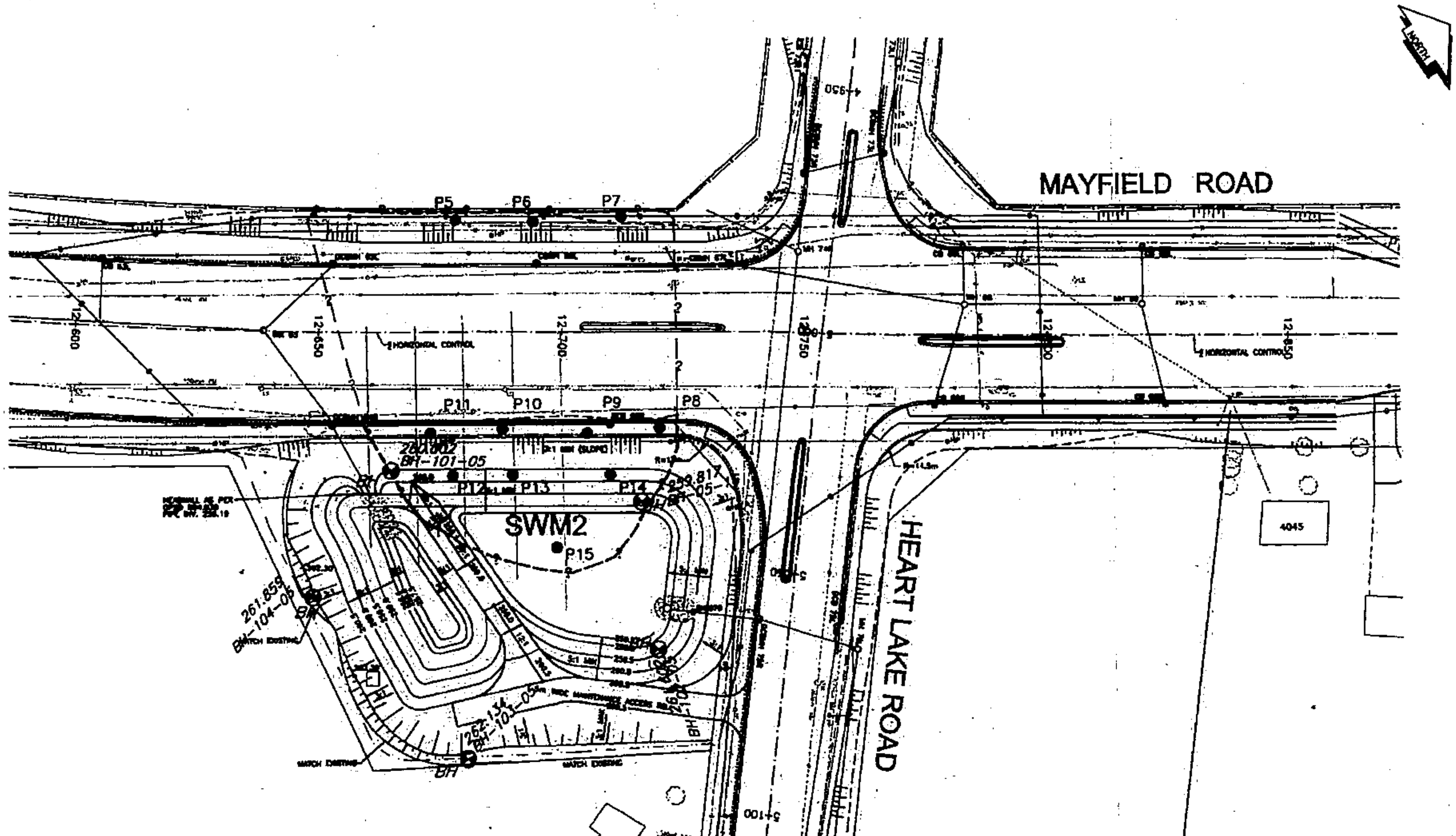


ENGINEER	MF	Stantec
DRAWN	SS	Geotechnical Investigation Mayfield Road Widening CULVERT AT STN.12+350
DATE	JUNE, 2005	
APPROVED	PKC	
SCALE	1:800	BOREHOLE LOCATION PLAN

THURBER
DRAWING NO. 17-308-292-3

JUNE, 2005
TED008292-1.DWG



LEGEND:

- BOREHOLE
- PEAT/SOFT SOIL PROBE LOCATION
- APPROXIMATE EXTENT OF PEAT/SOFT DEPOSIT BASED ON PROBE DATA

10 0 10 20m

Sheet 4 of 4

MF	Stantec		THURBER
SS	Geotechnical Investigation		
JUNE, 2006	Mayfield Road Widening		
PKC	SWM POND AT MAYFIELD/HEART LAKE ROAD		
1:800	BOREHOLE LOCATION PLAN		17-308-292-4

SYMBOLS, ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES

1. TEXTURAL CLASSIFICATION OF SOILS

CLASSIFICATION	PARTICLE SIZE	VISUAL IDENTIFICATION
Boulders	Greater than 200mm	same
Cobbles	75 to 200mm	same
Gravel	4.75 to 75mm	5 to 75mm
Sand	0.075 to 4.75mm	Not visible particles to 5mm
Silt	0.002 to 0.075mm	Non-plastic particles, not visible to the naked eye
Clay	Less than 0.002mm	Plastic particles, not visible to the naked eye

2. COARSE GRAIN SOIL DESCRIPTION (50% greater than 0.075mm)

TERMINOLOGY	PROPORTION
Trace or Occasional	Less than 10%
Some	10 to 20%
Adjective (e.g. silty or sandy)	20 to 35%
And (e.g. sand and gravel)	35 to 50%

3. TERMS DESCRIBING CONSISTENCY (COHESIVE SOILS ONLY)

DESCRIPTIVE TERM	UNDRAINED SHEAR STRENGTH (kPa)	APPROXIMATE SPT(1) 'N' VALUE
Very Soft	12 or less	Less than 2
Soft	12 to 25	2 to 4
Firm	25 to 50	4 to 8
Stiff	50 to 100	8 to 15
Very Stiff	100 to 200	15 to 30
Hard	Greater than 200	Greater than 30

NOTE: Hierarchy of Soil Strength Prediction
1) Laboratory Triaxial Testing
2) Field Insitu Vane Testing
3) Laboratory Vane Testing
4) SPT value
5) Pocket Penetrometer

4. TERMS DESCRIBING DENSITY (COHESIONLESS SOILS ONLY)

DESCRIPTIVE TERM	SPT "N" VALUE
Very Loose	Less than 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	Greater than 50

5. LEGEND FOR RECORDS OF BOREHOLES

SYMBOLS AND ABBREVIATIONS FOR SAMPLE TYPE

SS Split Spoon Sample · WS Wash Sample · AS Auger (Grab) Sample
TW Thin Wall Shelby Tube Sample · TP Thin Wall Piston Sample
PH Sampler Advanced by Hydraulic Pressure · PM Sampler Advanced by Manual Pressure
WH Sampler Advanced by Self Static Weight · RC Rock Core · SC Soil Core

$$\text{Sensitivity} = \frac{\text{Undisturbed Shear Strength}}{\text{Remoulded Shear Strength}}$$

▼ Water Level

C_{pen} Shear Strength Determination by Pocket Penetrometer

(1) SPT 'N' Value Standard Penetration Test 'N' Value – refers to the number of blows from a 63.5kg hammer free falling a height of 0.76m to advance a standard 50 mm outside diameter split spoon sampler for 0.3 m depth into undisturbed ground.

(2) DCPT Dynamic Cone Penetration Test – Continuous penetration of a 50 mm outside diameter, 60° conical steel point attached to "A" size rods driven by a 63.5 kg hammer free falling a height of 0.76 m. The resistance to cone penetration is the number of hammer blows required for each 0.3 m advance of the conical point into undisturbed ground.

UNIFIED SOILS CLASSIFICATION

MAJOR DIVISIONS		GROUP SYMBOL	TYPICAL DESCRIPTION
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	GW	Well-graded gravels or gravel-sand mixtures, little or no fines.
		GP	Poorly-graded gravels or gravel-sand mixtures, little or no fines.
		GM	Silty gravels, gravel-sand-silt mixtures.
		GC	Clayey gravels, gravel-sand-clay mixtures.
	SAND AND SANDY SOILS	SW	Well-graded sands or gravelly sands, little or no fines.
		SP	Poorly-graded sands or gravelly sands, little or no fines.
		SM	Silty sands, sand-silt mixtures.
		SC	Clayey sands, sand-clay mixtures.
FINE GRAINED SOILS	SILTS AND CLAYS $W_L < 50\%$	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays. ($W_L < 30\%$).
		CI	Inorganic clays of medium plasticity, silty clays. ($30\% < W_L < 50\%$).
		OL	Organic silts and organic silty-clays of low plasticity.
	SILTS AND CLAYS $W_L > 50\%$	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
		CH	Inorganic clays of high plasticity, fat clays.
		OH	Organic clays of medium to high plasticity, organic silts.
HIGHLY ORGANIC SOILS		Pt	Peat and other highly organic soils.
CLAY SHALE			
SANDSTONE			
SILTSTONE			
CLAYSTONE			
COAL			

EXPLANATION OF ROCK LOGGING TERMS

ROCK WEATHERING CLASSIFICATION

Fresh (FR)	No visible signs of weathering.
Fresh Jointed (FJ)	Weathering limited to the surface of major discontinuities.
Slightly Weathered (SW)	Penetrative weathering developed on open discontinuity surfaces, but only slight weathering of rock material.
Moderately Weathered (MW)	Weathering extends throughout the rock mass, but the rock material is not friable.
Highly Weathered (HW)	Weathering extends throughout the rock mass and the rock is partly friable.
Completely Weathered (CW)	Rock is wholly decomposed and in a friable condition, but the rock texture and structure are preserved.

SYMBOLS

CLAYSTONE

SILTSTONE

SANDSTONE

COAL

Bedrock (general)

DISCONTINUITY SPACING

Bedding	**Bedding Plane Spacing**
Very thickly bedded	Greater than 2m
Thickly bedded	0.6 to 2m
Medium bedded	0.2 to 0.6m
Thinly bedded	60mm to 0.2m
Very thinly bedded	20 to 60mm
Laminated	6 to 20mm
Thinly Laminated	Less than 6mm

TERMS

Total Core Recovery: (TCR)	Core recovered as a percentage of total core run length.
Solid Core Recovery: (SCR)	Percent Ratio of solid core of full cylindrical shape recovered. Expressed with respect to the total length of core run.
Rock Quality Designation: (RQD)	Total length of sound core recovered in pieces 0.1m in length or larger as a percentage of total core run length.
Uniaxial Compressive Strength (UCS)	Axial stress required to break the specimen
Fracture Index: (FI)	Frequency of natural fractures per 0.3m of core run.

STRENGTH CLASSIFICATION

Rock Strength	**Approximate Uniaxial Compressive Strength (MPa)**	**(psi)**	**Field Estimation of Hardness***
Extremely Strong	Greater than 250	Greater than 36,000	Specimen can only be chipped with a geological hammer
Very Strong	100-250	15,000 to 36,000	Requires many blows of geological hammer to break
Strong	50-100	7,500 to 15,000	Requires more than one blow of geological hammer to break
Medium Strong	25.0 to 50.0	3,500 to 7,500	Breaks under single blow of geological hammer.
Weak	5.0 to 25.0	750 to 3,500	Can be peeled by a pocket knife with difficulty
Very Weak	1.0 to 5.0	150 to 750	Can be peeled by a pocket knife, crumbles under firm blows of geological pick.
Extremely Weak (Rock)	0.25 to 1.0	35 to 150	Indented by thumbnail

THURBER

APPENDIX A

RECORD OF BOREHOLE SHEETS

TABLE A1

RECORD OF BOREHOLE 04-20C

THURBER

PROJECT : Mayfield Road Widening

LOCATION : Mayfield Road, Region of Peel

STARTED : 19 May 2005

COMPLETED : 19 May 2005

Project No. 17-308-292

SHEET 1 OF 1

DATUM

BORING METHOD: 210 mm HOLLOW STEM AUGERS

SOIL PROFILE – DESCRIPTION	ELEV. / DEPTH (m)	SAMPLE NUMBER	TYPE	BLOWS/0.3m	COMMENTS
GROUND SURFACE	249.65				
TOPSOIL, some rootlets, brown	249.48 / 0.17				
SILT, clayey, some sand, trace gravel, firm to stiff, brown: (CL-ML)		1	SS	6	
		2	SS	9	
SAND and SILT, some clay, trace gravel, very dense, brown: (SM)	248.13 / 1.52	3	SS	51	
		4	SS	54	
		5	SS	50/.100	
occasional cobbles and boulders					
wet sand layer between 3.96 and 4.27 m					
occasional cobbles and boulders		6	SS	52/.150	
wet sand layer between 5.49 and 5.79 m					
SILT, clayey, some sand, trace gravel, hard, grey: (TILL)(ML)	243.86 / 5.79	7	SS	84	Grain Size Analysis: Gr 7%/ Sa 32%/ Si 45%/ Cl 16%
wet sand layer between 7.0 and 7.47 m					
		8	SS	48	
END OF BOREHOLE AT 8.23 m. Well installation consists of 50 mm diameter Schedule 40 PVC pipe with a 1.52 m slotted screen.	241.42 / 8.23				

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH: Cu, KPa — nat V - ◆ ; rem V - ● ; Q - ✕ ; Cpen ▲ — 40 80 120 160

WATER CONTENT, PERCENT — wp ⊢—○w—⊣ wl — 10 20 30 40

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION:

Piezometer / standpipe	Elev. (m)
50 mm Well	
Grout	
Bentonite Seal	245.69 – 244.93
Filter Sand	
▽	243.55
Slotted Screen	
	242.03
	241.42

WATER LEVEL READINGS:

DATE	DEPTH (m)
26/05/05	5.97
30/05/05	6.10

DEPTH SCALE (metres): 1 2 3 4 5 6 7 8 9 10 11 12 13 14

GROUNDWATER ELEVATIONS

▽ SHALLOW/SINGLE INSTALLATION — WATER LEVEL (date)

▼ DEEP/DUAL INSTALLATION — WATER LEVEL (date)

LOGGED : MF

CHECKED : SP

THURBER

RECORD OF BOREHOLE 04-21

PROJECT : Mayfield Road Widening
LOCATION : Mayfield Road, Region of Peel
STARTED : 20 May 2005
COMPLETED : 20 May 2005

Project No. 17-308-292

SHEET 1 OF 1
DATUM

THURBER

Boring method: 100 mm SOLID STEM AUGERS

Description	Elev. / Depth (m)	Sample No.	Type	Blows/0.3m	Comments
GROUND SURFACE	252.41				
ASPHALT (125 mm)	0.00				
SAND and GRAVEL, trace silt, very dense, brown: (FILL)		1	SS	55	
SILT, sandy, clayey, trace gravel, very stiff, grey: (FILL)	251.66 / 0.76	2	SS	19	
		3	SS	16	
SAND and GRAVEL layer from 2.3m to 2.4m, very dense		4	SS	50/.150	
		5	SS	15	
SAND, gravelly, some silt, very dense to compact, brown: (SP)	248.68 / 3.73	6	SS	56	
SILT, clayey, some sand, trace gravel, occasional clay layers, occasional sand layers, stiff, brown: (TILL)(CL-ML)	247.53 / 4.88	7	SS	17	
		8	SS	12	
SILT, sandy, some clay, trace gravel, occasional wet sand layers, very dense, grey: (ML)	245.25 / 7.16	9	SS	50/.150	Grain Size Analysis: Gr 8%/ Sa 31%/ Si 51%/ Cl 10%
SAND, silty, some gravel, very dense, grey, wet: (SM)	243.72 / 8.69	10	SS	59	Grain Size Analysis: Gr 11%/ Sa 50%/ Si 35%/ Cl 4%
END OF BOREHOLE OPEN TO 9.76 m.	242.66 / 9.75				

END OF BOREHOLE OPEN TO 9.76 m. BOREHOLE OPEN TO 9.15 m AND WET AT 3.66 m.

BOREHOLE BACKFILLED AS FOLLOWED:
0 - 0.15 m Asphalt Patch
0.15 - 0.91 m Concrete
0.91 - 1.52 m Bentonite Holeplug
1.52 - 9.15 m Bentonite Grout

Column headings: DEPTH SCALE (metres); BORING METHOD; SOIL PROFILE (DESCRIPTION, STRATA PLOT, ELEV. DEPTH (m)); SAMPLES (NUMBER, TYPE, BLOWS/0.3m); COMMENTS — DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100; SHEAR STRENGTH: Cu, KPa (nat V - +, rem V - ●, Q - ✕, Cpen ▲) 40 80 120 160; WATER CONTENT, PERCENT (wp, w, wl) 10 20 30 40; ADDITIONAL LAB. TESTING; PIEZOMETER OR STANDPIPE INSTALLATION

GROUNDWATER ELEVATIONS

SHALLOW/SINGLE INSTALLATION — WATER LEVEL (date)
DEEP/DUAL INSTALLATION — WATER LEVEL (date)

LOGGED : MF
CHECKED : SP

RECORD OF BOREHOLE 105-05

PROJECT : Mayfield Road Widening
LOCATION : Mayfield Road, Region of Peel
STARTED : 16 May 2005
COMPLETED : 16 May 2005

Project No. 17-308-292

THURBER

SHEET 1 OF 1

DATUM

DEPTH SCALE (metres)	BORING METHOD	SOIL PROFILE – DESCRIPTION	ELEV. / DEPTH (m)	SAMPLES – NUMBER	TYPE	BLOWS/0.3m	COMMENTS
		GROUND SURFACE	257.56				
	210 mm HOLLOW STEM AUGERS	TOPSOIL, some rootlets, brown (150mm)	0.00				
		SILT, clayey, trace gravel, some sand, occasional cobbles, occasional rootlets, firm to very stiff, brown: (TILL)(ML)		1	SS	7	
1				2	SS	21	
2				3	SS	25	
		75 mm SAND layer, wet		4	SS	29	Grain Size Analysis: Gr 5%/ Sa 32%/ Si 50%/ Cl 14%
3		becoming very dense					
		SAND, some silt, trace clay, dense to very dense, brown: (SP)	254.21 3.35	5	SS	63	
4				6	SS	33	Grain Size Analysis: Gr 0%/ Sa 80%/ Si & Cl 20%
5				7	SS	44	
6				8	SS	69	
7							
8		becoming dense		9	SS	47	
9		becoming wet at 9.15 m, compact		10	SS	22	
10							
11		becoming dense at 10.67 m		11	SS	40	
		END OF BOREHOLE AT 11.28 m. Well installation consists of 50 mm diameter Schedule 40 PVC pipe with a 1.52 m slotted screen.	246.28 11.28				
12							
13							
14							

COMMENTS: DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100

SHEAR STRENGTH: Cu, KPa — nat V - +, rem V - ●, Q - X, Open ▲ — 40 80 120 160

WATER CONTENT, PERCENT — wp, w, wl — 10 20 30 40

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION:
50 mm Well
256.95
Grout
249.48
Bentonite Seal
248.87
Filter Sand
248.42
Slotted Screen
246.89
246.28

WATER LEVEL READINGS:

DATE	DEPTH (m)
16/05/05	9.40
26/05/05	9.43
30/05/05	9.44

GROUNDWATER ELEVATIONS

▽ SHALLOW/SINGLE INSTALLATION — WATER LEVEL (date)

▼ DEEP/DUAL INSTALLATION — WATER LEVEL (date)

LOGGED : MF
CHECKED : SP

THURBER

RECORD OF BOREHOLE 106-05

PROJECT : Mayfield Road Widening
LOCATION : Mayfield Road, Region of Peel
STARTED : 16 May 2005
COMPLETED : 16 May 2005

Project No. 17-308-292
SHEET 1 OF 1
DATUM

THURBER

BORING METHOD: 210 mm HOLLOW STEM AUGERS

DESCRIPTION	ELEV. / DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	COMMENTS	PIEZOMETER OR STANDPIPE INSTALLATION
GROUND SURFACE	257.79					
TOPSOIL: trace rootlets; brown (150mm)	0.00					50 mm Well 257.18
SILT, clayey, some sand, trace gravel, occasional rootlets, occasional sand lenses, very stiff, brown: (TILL)(CL-ML)		1	SS	6		
		2	SS	21	Grain Size Analysis: Gr 1%/ Sa 27%/ Si 56%/ Cl 16%	
		3	SS	28		Grout
SAND, silty, some gravel, dense, brown: (SM)	255.66 / 2.13	4	SS	49	Grain Size Analysis: Gr 20%/ Sa 49%/ Si & Cl 31%	
SILT, sandy, trace clay, compact, brown: (ML-NONPLASTIC)	254.82 / 2.97	5	SS	16		
wet at 3.8 m		6	SS	24	Grain Size Analysis: Gr 0%/ Sa 33%/ Si 63%/ Cl 5%	
		7	SS	12		
SAND, silty, dense, brown: (SM)	251.69 / 6.10	8	SS	39		
SAND, trace silt, dense to compact, brown: (SP)	250.17 / 7.62	9	SS	34		249.71; Bentonite Seal 249.41
wet at 9.1 m		10	SS	26		Filter Sand 248.66; Slotted Screen
becoming grey		11	SS	19		247.12
END OF BOREHOLE AT 11.28 m. Well installation consists of 50 mm diameter Schedule 40 PVC pipe with a 1.52 m slotted screen.	246.51 / 11.28					246.51

WATER LEVEL READINGS:

DATE	DEPTH (m)
16/05/05	9.50
26/05/05	9.50
30/05/05	9.50

SHEAR STRENGTH: Cu, KPa — nat V - ✦, rem V - ●, Q - ✕, Cpen ▲ (40, 80, 120, 160)
WATER CONTENT, PERCENT — wp, w, wl (10, 20, 30, 40)
DYNAMIC CONE PENETRATION RESISTANCE PLOT (20, 40, 60, 80, 100)
ADDITIONAL LAB. TESTING

GROUNDWATER ELEVATIONS

SHALLOW/SINGLE INSTALLATION — WATER LEVEL (date)
DEEP/DUAL INSTALLATION — WATER LEVEL (date)

LOGGED : MF
CHECKED : SP

RECORD OF BOREHOLE 05-3

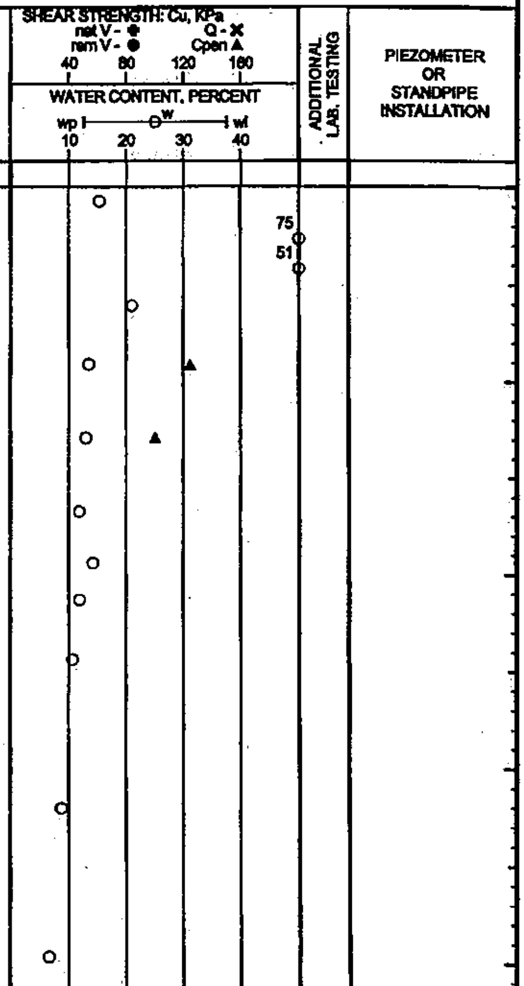
PROJECT : Mayfield Road Widening
LOCATION : Mayfield Road, Region of Peel
STARTED : 16 May 2005
COMPLETED : 16 May 2005

Project No. 17-308-292

SHEET 1 OF 1
DATUM

THURBER

DEPTH SCALE (metres)	BORING METHOD	DESCRIPTION	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	COMMENTS
		GROUND SURFACE	256.83				
	210 mm HOLLOW STEM AUGERS	TOPSOIL, some rootlets, trace gravel, brown	0.00	1	SS	6	
		PEAT, silty, black	256.45 / 0.38				
1		CLAY, silty, some sand, trace gravel, firm, grey: (CL)	255.84 / 0.99	2	SS	5	
		SILT, clayey, some sand, trace gravel, stiff, grey: (TILL)(CL-ML)	255.31 / 1.52	3	SS	9	
2				4	SS	9	
3		wet sand layer		5	SS	11	
4		wet sand layer; stiff to hard		6	SS	13	
5				7	SS	16	
6				8	SS	47	
7		BOULDER	249.97 / 249.86				
		SAND, fine grained, trace silt, dense, brown: (SP)	7.01				
8				9	SS	35	
		END OF BOREHOLE AT 8.23 m. BOREHOLE OPEN TO 7.32 m AND WATER LEVEL AT 6.10 m UPON COMPLETION. BOREHOLE GROUTED WITH BENTONITE GROUT TO 1.52 m AND TO SURFACE WITH BENTONITE HOLEPLUG.	248.60 / 8.23				



GROUNDWATER ELEVATIONS

SHALLOW/SINGLE INSTALLATION
WATER LEVEL (date)

DEEP/DUAL INSTALLATION
WATER LEVEL (date)

LOGGED : MF
CHECKED : SP

THURBER

HURBER2S 6292.GPJ

RECORD OF BOREHOLE 05-6

PROJECT : Mayfield Road Widening
LOCATION : Mayfield Road, Region of Peel
STARTED : 17 May 2005
COMPLETED : 17 May 2005

Project No. 17-308-292

SHEET 1 OF 1
DATUM

THURBER

DEPTH SCALE (metres)	BORING METHOD	DESCRIPTION	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	WATER CONTENT (%) / SHEAR STRENGTH
	100 mm SOLID STEM AUGERS	GROUND SURFACE	255.49				
		PEAT, some silt, trace clay, trace gravel, some rootlets, very loose to compact, dark brown, wet water flowing into borehole	0.00	1	SS	0	72
1				2	SS	10	66
		SILT, clayey, some sand, trace gravel, firm to stiff, grey: (TILL)(CL-ML)	254.35 1.14	3	SS	4	
2				4	SS	7	
3				5	SS	11	
				6	SS	14	
		END OF BOREHOLE AT 3.66 m. BOREHOLE OPEN TO 3.66 m AND WATER LEVEL TO SURFACE ON COMPLETION. BOREHOLE BACKFILLED WITH DRILL CUTTINGS.	251.63 3.66				

Column headings: SOIL PROFILE; STRATA PLOT; SAMPLES; COMMENTS; DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100); SHEAR STRENGTH: Cu, KPa — nat V, rem V, Q - X, Cpen ▲ (40 80 120 160); WATER CONTENT, PERCENT — wp, w, wl (10 20 30 40); ADDITIONAL LAB. TESTING; PIEZOMETER OR STANDPIPE INSTALLATION

Depth scale: 1 2 3 4 5 6 7 8 9 10 11 12 13 14

GROUNDWATER ELEVATIONS

SHALLOW/SINGLE INSTALLATION — WATER LEVEL (date)

DEEP/DUAL INSTALLATION — WATER LEVEL (date)

LOGGED : MF
CHECKED : SP

THURBER

THURBER2S 8292.GPJ

RECORD OF BOREHOLE 05-7

PROJECT : Mayfield Road Widening
LOCATION : Mayfield Road, Region of Peel
STARTED : 17 May 2005
COMPLETED : 17 May 2005

Project No. 17-308-292

SHEET 1 OF 1
DATUM

THURBER

DEPTH SCALE (metres)	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	WATER CONTENT, PERCENT (w)
		GROUND SURFACE		255.48				
	100 mm SOLID STEM AUGERS	PEAT, sandy, some silt, trace clay, trace gravel, some rootlets, very loose, dark brown, wet		0.00	1	SS	0	55
1		SILT, clayey, some sand, trace gravel, very stiff to stiff, grey: (TILL)(CL-ML)		254.95 / 0.53	2	SS	15	
					3	SS	6	
2					4	SS	8	
					5	SS	15	
3					6	SS	13	
		END OF BOREHOLE AT 3.66 m. BOREHOLE OPEN TO 3.66 m AND WATER LEVEL AT 1.52 m UPON COMPLETION. BOREHOLE BACKFILLED WITH DRILL CUTTINGS.		251.82 / 3.66				

Other column headings: COMMENTS; DYNAMIC CONE PENETRATION RESISTANCE PLOT (20, 40, 60, 80, 100); SHEAR STRENGTH: Cu, KPa (nat V - ◆, rem V - ●, Q - ✕, Cpen ▲; 40, 80, 120, 160); WATER CONTENT, PERCENT (wp, w, wl; 10, 20, 30, 40); ADDITIONAL LAB. TESTING; PIEZOMETER OR STANDPIPE INSTALLATION

Depth scale: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14

GROUNDWATER ELEVATIONS

SHALLOW/SINGLE INSTALLATION — WATER LEVEL (date)
DEEP/DUAL INSTALLATION — WATER LEVEL (date)

LOGGED : MF
CHECKED : SP

THURBER

RECORD OF BOREHOLE 05-8

PROJECT : Mayfield Road Widening
LOCATION : Mayfield Road, Region of Peel
STARTED : 17 May 2005
COMPLETED : 17 May 2005

Project No. 17-308-292
SHEET 1 OF 1
DATUM

THURBER

DEPTH SCALE (metres)	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	COMMENTS	WATER CONTENT, PERCENT (w)
		GROUND SURFACE		255.53					
	100 mm SOLID STEM AUGERS	PEAT, sandy, some silt, trace clay, some rootlets, very loose, blackish grey		0.00	1	SS	0		~24
		SILT, clayey, some sand, trace gravel, firm to stiff, grey: (TILL)(ML)		255.00 / 0.53	2	SS	5		~16
1					3	SS	8		~17
2					4	SS	8		~14
					5	SS	10		~11
3					6	SS	8		~12
		END OF BOREHOLE AT 3.66 m. BOREHOLE OPEN TO 3.66 m. BOREHOLE OPEN TO 3.66 m AND WATER LEVEL AT 2.44 m UPON COMPLETION. BOREHOLE BACKFILLED WITH DRILL CUTTINGS.		251.87 / 3.66					

Column headings: COMMENTS — DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100; SHEAR STRENGTH: Cu, KPa — nat V - ◆ Q - ✖ rem V - ● Cpen ▲ 40 80 120 160; WATER CONTENT, PERCENT — wp ⊢ w ⊖ ⊣ wl 10 20 30 40; ADDITIONAL LAB. TESTING; PIEZOMETER OR STANDPIPE INSTALLATION

Depth scale: 1 2 3 4 5 6 7 8 9 10 11 12 13 14

GROUNDWATER ELEVATIONS

∇ SHALLOW/SINGLE INSTALLATION — WATER LEVEL (date)

▼ DEEP/DUAL INSTALLATION — WATER LEVEL (date)

LOGGED : MF
CHECKED : SP

THURBER

RECORD OF BOREHOLE 101-05

PROJECT : Mayfield Road Widening
LOCATION : Mayfield Road, Region of Peel
STARTED : 19 May 2005
COMPLETED : 19 May 2005

Project No. 17-308-292

SHEET 1 OF 1
DATUM

DEPTH SCALE (metres)	BORING METHOD	DESCRIPTION	ELEV. DEPTH (m)	SAMPLE NUMBER	TYPE	BLOWS/0.3m	COMMENTS	WATER CONTENT (%)	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE	260.00 0.00						
	210 mm HOLLOW STEM AUGERS	TOPSOIL, sandy, some silt, some rootlets, trace clay, very loose, dark brown		1	SS	0		75	50 mm Well 259.70
1		CLAY, silty, some sand, trace to some gravel, stiff, brown: (TILL)(CL)	259.47 0.53	2	SS	10			
2		SILT, clayey, some sand, trace gravel, stiff to very stiff, brown to grey: (TILL)(CL-ML)	258.63 1.37	3	SS	12			Grout
3				4	SS	17	Grain Size Analysis: Gr 16%/ Sa 36%/ Si 33%/ Cl 15%		
5				5	SS	30			255.12 Bentonite Seal 254.51
6				6	SS	24			Filter Sand 253.90 Slotted Screen
8				7	SS	25			252.38 251.77
		END OF BOREHOLE AT 8.23 m. Well installation consists of 50 mm diameter Schedule 40 PVC pipe with a 1.52 m slotted screen.	251.77 8.23						

SHEAR STRENGTH: Cu, KPa — nat V - ✚, rem V - ●, Q - ✖, Cpen ▲ (40, 80, 120, 160)

WATER CONTENT, PERCENT: wp, w, wl (10, 20, 30, 40)

COMMENTS: DYNAMIC CONE PENETRATION RESISTANCE PLOT (20, 40, 60, 80, 100)

ADDITIONAL LAB. TESTING

WATER LEVEL READINGS:

DATE	DEPTH (m)
19/05/05	Dry
26/05/05	7.75
30/05/05	7.47

GROUNDWATER ELEVATIONS

∇ SHALLOW/SINGLE INSTALLATION — WATER LEVEL (date)

▼ DEEP/DUAL INSTALLATION — WATER LEVEL (date)

LOGGED : MF

CHECKED : SP

THURBER

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RECORD OF BOREHOLE 102-05

PROJECT : Mayfield Road Widening
LOCATION : Mayfield Road, Region of Peel
STARTED : 18 May 2005
COMPLETED : 18 May 2005

Project No. 17-308-292

SHEET 1 OF 1
DATUM

THURBER

DEPTH SCALE (metres)	BORING METHOD	DESCRIPTION	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	COMMENTS	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE	261.60					
	100 mm SOLID STEM AUGERS	TOPSOIL: (175 mm)	[illegible] 0.17					50 mm Well
		SILT, clayey, some sand, trace gravel, hard, brown, moist: (TILL)(CL-ML)		1	SS	3		Bentonite Seal 260.69
2				2	SS	34	Grain Size Analysis: Gr 6%/ Sa 35%/ Si 40%/ Cl 19%	
3								Grout
				3	SS	29		
4		augers grinding						
		becoming grey						
5				4	SS	47	Grain Size Analysis: Gr 5%/ Sa 33%/ Si 41%/ Cl 21%	▽
6				5	SS	38		255.20
7			254.44 7.16					Bentonite Seal 254.69
		SILT, trace sand, dense to compact, grey, wet: (ML-NONPLASTIC) augers grinding at 7.3 m						Filter Sand 253.98
8				6	SS	34		Slotted Screen
9								252.46
			251.85 9.75	7	SS	16		251.85
10		END OF BOREHOLE AT 9.75 m. Well installation consists of 50 mm diameter Schedule 40 PVC pipe with a 1.52 m Slotted screen.						
11		WATER LEVEL READINGS:						
12								
13								
14								

WATER LEVEL READINGS:

DATE	DEPTH (m)
18/05/05	Dry
19/05/05	7.20
26/05/05	5.60
30/05/05	5.50

SHEAR STRENGTH: Cu, KPa — nat V - ✚ ; rem V - ● ; Q - ✖ ; Cpen ▲ — 40 80 120 160
WATER CONTENT, PERCENT — wp ├──○w──┤ wl — 10 20 30 40
DYNAMIC CONE PENETRATION RESISTANCE PLOT — 20 40 60 80 100
ADDITIONAL LAB. TESTING

GROUNDWATER ELEVATIONS

▽ SHALLOW/SINGLE INSTALLATION — WATER LEVEL (date)
▼ DEEP/DUAL INSTALLATION — WATER LEVEL (date)

LOGGED : MF
CHECKED : SP

THURBER

RECORD OF BOREHOLE 103-05

PROJECT : Mayfield Road Widening
LOCATION : Mayfield Road, Region of Peel
STARTED : 18 May 2005
COMPLETED : 18 May 2005

Project No. 17-308-292

THURBER

SHEET 1 OF 1

DATUM

SHEAR STRENGTH: Cu, KPa — net V - ✚ ; rem V - ● ; Q - ✖ ; Cpen ▲ ; 40, 80, 120, 160

WATER CONTENT, PERCENT — wp, w, wl ; 10, 20, 30, 40

COMMENTS — DYNAMIC CONE PENETRATION RESISTANCE PLOT — 20, 40, 60, 80, 100

BORING METHOD: 100 mm SOLID STEM AUGERS

DEPTH SCALE (metres)	DESCRIPTION	ELEV. / DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	COMMENTS	PIEZOMETER OR STANDPIPE INSTALLATION
	GROUND SURFACE	262.13					
	TOPSOIL	0.00					50 mm Well
	SILT, clayey, some sand, trace gravel, very stiff to hard, brown: (TILL)(CL-ML)	261.83 / 0.30	1	SS	5		
1							Bentonite Seal 261.22
2			2	SS	22		
3			3	SS	65	Grain Size Analysis: Gr 8%/ Sa 37%/ Si 36%/ Cl 18%	Grout
4							
5			4	SS	62		
6	becoming grey, hard augering						∇ 256.03
			5	SS	65		Bentonite Seal 256.12
7	occasional silt layers						Filter Sand 254.51
8			6	SS	53		Slotted Screen
9							252.99
		252.38 / 9.75	7	SS	26		252.38
10	END OF BOREHOLE AT 9.75 m. Well installation consists of 50 mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.						

WATER LEVEL READINGS:

DATE	DEPTH (m)
18/05/05	5.93
26/05/05	6.15
30/05/05	6.10

GROUNDWATER ELEVATIONS

∇ SHALLOW/SINGLE INSTALLATION — WATER LEVEL (date)

▼ DEEP/DUAL INSTALLATION — WATER LEVEL (date)

LOGGED : MF
CHECKED : SP

THURBER

RECORD OF BOREHOLE 104-05

PROJECT : Mayfield Road Widening
LOCATION : Mayfield Road, Region of Peel
STARTED : 17 May 2005
COMPLETED : 17 May 2005

Project No. 17-308-292

SHEET 1 OF 1
DATUM

THURBER

DEPTH SCALE (metres)	BORING METHOD	DESCRIPTION	ELEV. / DEPTH (m)	SAMPLE NUMBER	TYPE	BLOWS/0.3m	COMMENTS
	100 mm SOLID STEM AUGERS	GROUND SURFACE	261.86				
		TOPSOIL: (150 mm)	0.00				
		SILT, clayey, some sand, trace gravel, very stiff to hard, brown: (TILL)(CL-ML)		1	SS	10	
1				2	SS	12	
2				3	SS	20	
				4	SS	26	
3				5	SS	42	
4				6	SS	39	
5		becoming grey		7	SS	30	Grain Size Analysis: Gr 4%/ Sa 37%/ Si 39%/ Cl 19%
6		auger grinding on boulder		8	SS	50/ .075	
7							
8		SILT, sandy, trace gravel, occasional cobbles and boulders, very dense, grey: (ML-NONPLASTIC) augers grinding at 6 - 6.5 m	254.24 / 7.62	9	SS	71	
9		SILT, clayey, some sand, trace gravel, hard, grey: (TILL)(CL-ML)	252.72 / 9.14	10	SS	33	
10		END OF BOREHOLE AT 9.76 m. Well installation consists of 50 mm diameter Schedule 40 PVC pipe with a 1.52 m slotted screen.	252.11 / 9.76				

SHEAR STRENGTH: Cu, KPa (nat V - +, rem V - ●, Q - ✕, Cpen ▲): 40, 80, 120, 160
DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20, 40, 60, 80, 100
WATER CONTENT, PERCENT (wp, w, wl): 10, 20, 30, 40
ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION:
50 mm Well
Bentonite Seal – 260.34
Grout
▽ 255.76
Bentonite Seal – 254.85
Filter Sand – 254.24
Slotted Screen – 252.72
252.11

WATER LEVEL READINGS:

DATE	DEPTH (m)
17/05/05	7.55
26/05/05	6.00
30/05/05	6.10

GROUNDWATER ELEVATIONS
▽ SHALLOW/SINGLE INSTALLATION – WATER LEVEL (date)
▼ DEEP/DUAL INSTALLATION – WATER LEVEL (date)

LOGGED : MF
CHECKED : SP

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RECORD OF BOREHOLE 05-16

PROJECT : Mayfield Road Widening
LOCATION : Mayfield Road, Region of Peel
STARTED : 19 May 2005
COMPLETED : 19 May 2005

Project No. 17-308-292

SHEET 1 OF 1

DATUM

THURBER

DEPTH SCALE (metres)	BORING METHOD	DESCRIPTION	ELEV. / DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	COMMENTS	WATER CONTENT, PERCENT (w)	ADDITIONAL LAB. TESTING
	210 mm HOLLOW STEM AUGERS	GROUND SURFACE	259.62						
		TOPSOIL, sandy, some silt, some rootlets, trace gravel, very loose, black/grey	0.00	1	SS	1		~28	
1		CLAY, silty to SILT, clayey, some sand, trace gravel, very stiff, brown: (TILL)(CL-ML)	258.98 / 0.64	2	SS	18		~13	▲
		SILT, clayey, some sand, trace gravel, occasional sand pockets, stiff to very stiff, brown to grey: (TILL)(CL-ML)	258.52 / 1.30						
2				3	SS	11		~14	
3				4	SS	18		~10	
5				5	SS	29		~10	
6				6	SS	30		~16	
7		END OF BOREHOLE AT 6.71 m. BOREHOLE OPEN TO 6.1 m AND DRY UPON COMPLETION. BOREHOLE GROUTED WITH BENTONITE QUICK-GROUT TO 1.52 m AND WITH BENTONITE HOLEPLUG TO SURFACE.	253.11 / 6.71						

Column headings: SOIL PROFILE; STRATA PLOT; SAMPLES; COMMENTS — DYNAMIC CONE PENETRATION RESISTANCE PLOT (20, 40, 60, 80, 100); SHEAR STRENGTH: Cu, KPa — nat V - ✚, rem V - ●, Q - ✖, Cpen ▲ (40, 80, 120, 160); WATER CONTENT, PERCENT — wp, w, wl (10, 20, 30, 40); PIEZOMETER OR STANDPIPE INSTALLATION.

Depth scale: 1 – 14 m

GROUNDWATER ELEVATIONS

▽ SHALLOW/SINGLE INSTALLATION — WATER LEVEL (date)

▼ DEEP/DUAL INSTALLATION — WATER LEVEL (date)

LOGGED : MF
CHECKED : SP

THURBER

RECORD OF BOREHOLE 05-10

PROJECT : Mayfield Road Widening
Project No. 17-308-292
LOCATION : Mayfield Road, Region of Peel
STARTED : 19 May 2005
COMPLETED : 19 May 2005

THURBER

SHEET 1 OF 1
DATUM

DEPTH SCALE (metres)	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	COMMENTS / DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)	SHEAR STRENGTH: Cu, KPa (nat V - ✚, rem V - ●, Q - ✖, Cpen ▲; 40 80 120 160) / WATER CONTENT, PERCENT (wp ├─o w─┤ wl; 10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		254.95							
	210 mm HOLLOW STEM AUGERS	TOPSOIL, some rootlets, brown (80mm)		0.00							
		SILT, clayey, some sand, trace gravel, firm to stiff, brown: (TILL)(CL-ML)			1	SS	2				
1					2	SS	3				
2					3	SS	8				
3					4	SS	13				
					5	SS	6				
4					6	SS	7				
5				249.77 / 5.18	7	SS	9				
6		END OF BOREHOLE AT 5.18 m. BOREHOLE OPEN TO 4.57 m AND DRY UPON COMPLETION. BOREHOLE GROUTED WITH BENTONITE QUICK-GROUT TO SURFACE.									
7											
8											
9											
10											
11											
12											
13											
14											

GROUNDWATER ELEVATIONS

∇ SHALLOW/SINGLE INSTALLATION — WATER LEVEL (date)

$\blacktriangledown$ DEEP/DUAL INSTALLATION — WATER LEVEL (date)

LOGGED : MF
CHECKED : SP

THURBER

RECORD OF BOREHOLE 05-11

PROJECT : Mayfield Road Widening

LOCATION : Mayfield Road, Region of Peel

STARTED : 19 May 2005

COMPLETED : 19 May 2005

Project No. 17-308-292

SHEET 1 OF 1

DATUM

THURBER

SHEAR STRENGTH: Cu, KPa — nat V - ✚, rem V - ●, Q - ✖, Cpen ▲ (40, 80, 120, 160)

WATER CONTENT, PERCENT — wp, w, wl (10, 20, 30, 40)

COMMENTS — DYNAMIC CONE PENETRATION RESISTANCE PLOT (20, 40, 60, 80, 100)

DEPTH SCALE (metres)	BORING METHOD	DESCRIPTION	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING
	210 mm HOLLOW STEM AUGERS	GROUND SURFACE	254.07 / 0.00				
		TOPSOIL, some rootlets, brown, dark brown (125mm)		1	SS	5	
1		SILT, clayey, some sand, trace gravel, firm to soft, brown: (FILL)		2	SS	2	
2		PEAT, clayey, some sand and silt, occasional wood fragments, very soft, black, moist	252.55 / 1.52	3	SS	1	150
3				4	SS	0	59
							78
4		SILT, sandy, some rootlets and wood fragments, very loose to compact, grey: (ML-NONPLASTIC)	250.72 / 3.35	5	SS	1	
				6	SS	4	
5				7	SS	20	
		END OF BOREHOLE AT 5.18 m. BOREHOLE OPEN TO 4.57 m AND WATER LEVEL AT 2.44 m UPON COMPLETION. BOREHOLE GROUTED WITH BENTONITE GROUT TO 0.3 m AND WITH BENTONITE HOLEPLUG TO SURFACE.	248.89 / 5.18				

Depth scale continues: 6, 7, 8, 9, 10, 11, 12, 13, 14

PIEZOMETER OR STANDPIPE INSTALLATION

GROUNDWATER ELEVATIONS

▽ SHALLOW/SINGLE INSTALLATION — WATER LEVEL (date)

▼ DEEP/DUAL INSTALLATION — WATER LEVEL (date)

LOGGED : MF

CHECKED : SP

THURBER

Region of Peel
Working for you

CANADA AWARDS FOR EXCELLENCE
GOLD RECIPIENT QUALITY 2006

August 15, 2008
File: 01-4830

BY MAIL AND E-MAIL (slingertat@trca.on.ca)

Sharon Lingertat
Planner II, Environmental Assessment Review
Planning and Development
Toronto and Region Conservation Authority
5 Shoreham Drive
Downsview, ON
M3N 1S4

Dear Sharon:

Re: TRCA File CFN 36211
x ref CFN 36212, 32971, 37765
Response to Fill, Construction and Alteration to Waterways Application, #038/05/CAL
Mayfield Road Improvements (Inder Heights Drive to east of Kennedy Road) and Stormwater Management Pond – Detailed Design Submission #5
Etobicoke Creek Watershed; City of Brampton and Town of Caledon; Regional Municipality of Peel

Further to the additional information requested in your August 14, 2008 correspondence, Item A14, this serves to confirm that the Region of Peel will be responsible for the maintenance of the Kennedy Road Stormwater Management Pond, which will be constructed as part of the Mayfield Road Widening – Phase 2 and 3. The Region of Peel also acknowledges that the sediment forebay was designed to have a cleanout frequency of 8 years, which is more frequent than the standard 10-year occurrence, as recommended by MOE.

Should you have any questions or require further information, please contact the undersigned at 905-791-7800 ext. 7813 or by e-mail at jose.montouto@peelregion.ca.

Yours truly,

Jose Montouto, P. Eng.
Project Manager
Region of Peel
Environment, Transportation & Planning Services

BY E-MAIL

cc:	Region of Peel:	Gary Kocialek
	Stantec:	Dave Hallman
		Martin Goorts

From: Innes, Jayson
To: Goorts, Martin;
Subject: Mayfield Road
Date: Wednesday, April 27, 2011 3:15:30 PM

I have cut out the maintenance sections from both SWM reports. They seem to cover most of the points you mentioned. Let me know if you need more information.

Kennedy

Maintenance Report

Monitoring and maintenance activities are an important part of a stormwater management plan to ensure that the designed features continue to operate as intended. Long term monitoring and maintenance should involve annual inspections of the stormwater management facilities and downstream areas. The following section is intended to provide guidance for long term maintenance of the stormwater management facility.

- Annual Inspections – during annual inspections, the following items should be recorded:

  - Is the regular pond level above or below the permanent pool elevation (255.55m)?
  - Damage to facility structures including headwalls, pipes, DICB, berms, maintenance accesses, etc.
  - Condition of vegetation
  - Visual characteristics of ponded water in facility (i.e. oily sheen, colour, etc.)
  - Sediment depth and oil accumulation in wetland forebay
  - Erosion around outlet structure (overflow weir and gabion basket) or downstream areas

- Annual Maintenance – tasks to be performed during, or as a result of, annual inspections

- Clear blockages and repair damage to SWM facility structures including inlet and outlet pipes, outlet risers, inlet manholes

- Clear accumulated debris from stone jacket around riser. Any trash or debris removed from around the SWM facility should be disposed of in a legal and appropriate location

- Inspect and repair erosion. Install slope reinforcement products or revegetate as necessary

- Sediment must be removed from the facility after a period of approximately 8 years. Sediment should be removed from the forebays when sediment accumulation reaches 254.5 m or when sediment depths reach 0.5 m. This will equate to a water depth in the forebay of approximately 1.05 m if permanent pool elevations remain as designed.

* Forebay Maintenance Guidelines

  - Gravity drainage of the pond is not possible because ground elevations in the surrounding Heart Lake Wetland are similar to those within the pond. Draining of the pond will be accomplished through pumping when maintenance is required. The pond should be pumped out over a 24 hour period in order to reduce peak flows to the wetland

  - Removal and disposal of sediment from all facilities should be completed by a qualified party and/or licensed contractor.

  - An annual loading rate of 1.0 m^3/ha was assumed based on the average catchment imperviousness of 41% and Table 6.3 of the MOE *Stormwater Management Planning and Design Manual*, (March 2003). Sediment accumulation should be monitored and clean-out frequency confirmed over an extended period to ensure that sediment depths do not exceed 0.5 m.

* Liner Maintenance Guidelines

  - In the event that the liner fails, the recommended Bentofix repair scheme should be implemented